



Colorado Boulevard Corridor Study

Final Report

December 2023



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Abbreviations and Acronyms

ADT	Average Daily Traffic
AADT	Average Annual Daily Traffic
AASHTO	American Association of State and Highway Transportation Officials
AWSC	All Way Stop Control
BHE	Black Hills Energy
CGT	Continuous Green T
EB	Eastbound
EPDO	Equivalent Property Damage Only
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
F+I	Fatal and Injury
GIS	Geographic Information System
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
IHSDM	Interactive Highway Safety Design Module
LF	Linear Feet
LOS	Level of Service
LPI	Leading Pedestrian Interval
M&A	Methods and Assumptions
MDU	Montana Dakota Utilities
MEV	Million Entering Vehicles
MOE	Measure of Effectiveness
MPH	Miles per Hour
MTP	Master Transportation Plan
MUTCD	Manual on Uniform Traffic Control Devices
MVMT	Million Vehicle Miles Traveled
NB	Northbound
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NLEB	Northern Long Eared Bat
NRHP	National Register of Historic Places
PDO	Property Damage Only
PHB	Pedestrian Hybrid Beacon
PHT	Prairie Hills Transit



PVI	Point of Vertical Intersection
RIRO	Right-in Right-out
ROW	Right-of-Way
RPZ	Runway Protection Zone
RRFB	Rectangular Rapid Flashing Beacon
SAT	Study Advisory Team
SB	Southbound
SDDOT	South Dakota Department of Transportation
SDN	South Dakota Network
SPI	Single Point Interchange
STIP	Statewide Transportation Improvement Plan
TMC	Turning Movement Count
TWSC	Two Way Stop Control
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WB	Westbound
WB-67	Tractor-Trailer with a Wheelbase of 67 feet
WCSC	Worst Case Stop Controlled
VMT	Vehicle-Miles Traveled
VPD	Vehicles Per Day
VPI	Vertical Point of Intersection

Executive Summary

ES.1 Purpose of the Study

The City of Spearfish in conjunction with the South Dakota Department of Transportation (SDDOT) conducted a corridor planning study for a portion of the Colorado Boulevard corridor within the City of Spearfish, South Dakota. Spearfish is expecting significant growth in the immediate area of Colorado Boulevard from 27th Street to US85. Up until recently, Colorado Boulevard has largely served east-west through traffic. However, the corridor is beginning to serve as the primary means of access to developing areas along and south of the corridor.

The purpose of future project(s) recommended in this report is to address the increasing traffic volumes on Colorado Boulevard and provide solutions to mitigate the lack of pedestrian/bicycle connectivity between the eastern extent of the existing bike path and the new sports complex near US85.

ES.2 Study Process

This Study used the following four-step process to develop corridor recommendations. The Study Advisory Team (SAT), public, and stakeholder involvement were all instrumental in a process that included one SAT workshop, two stakeholder meetings, and two public meetings.

Table ES 1. Summary of the Study Process and Applicable Report Sections

Step	Outcome	Applicable Report Sections
1	Identify Transportation Issues and Needs	Sections 3-4
2	Develop Concepts	Section 5
3	Develop Feasible Solutions for the Project	Section 6-7
4	Develop Recommendations	Section 8-9

The Colorado Boulevard Corridor Study focuses on three key elements:

1. Gaining an understanding of Colorado Boulevard corridor transportation issues and needs through public engagement, review of existing, and future conditions
2. Developing projects to address the identified issues and needs
3. Developing an Implementation Plan to present a feasible path to implement the Study recommendations

ES.3 Study Findings and Recommendations

The build alternatives were evaluated based on meeting the future traffic operations, comparative costs, ROW acquisition, potential environmental impacts, traffic safety, bicycle and pedestrian considerations, and stakeholder/public input.

Ultimately, the SAT preferred intersection and roadway segment alternatives are summarized in **Table ES 2**. The preferred recreation path alternative was to locate the path on the north side of the roadway. The preferred in-street bike facility option was Option 3c, uni-directional buffered bike lanes in the same direction of traffic on either side of the roadway.

Table ES 2. Summary of Preferred Intersection and Roadway Segment Alternatives

Intersection	Improvement Type
27th Street Intersection	Traditional Signal – Widening Project – Intersection Capacity Improvements Only
Heritage Drive Intersection	Traditional Signal
Road Segment 1 - Heritage Drive to Maitland Road	5 Lane Section w/ Pedestrian Underpass at False Bottom Creek
Maitland Road Intersection	Roundabout
Road Segment 2 - Maitland Road to Rainbow Road	5 Lane Section w/ Pedestrian Underpass at Tetro Creek
Rainbow Road Intersection	Roundabout
Road Segment 3 -	3 Lane Section
Rainbow Road to Aurora Avenue	3 Lane Section w/ Pedestrian Underpass at Miller Creek (Separate Planned Structure Project)

1.0 Introduction

The City of Spearfish in conjunction with the South Dakota Department of Transportation (SDDOT) conducted a corridor planning study for a portion of the Colorado Boulevard corridor within the City of Spearfish, South Dakota. Spearfish is expecting significant growth in the immediate area. Up until recently, Colorado Boulevard has largely served east-west through traffic. However, the corridor is beginning to serve as the primary means of access to areas along and south of the corridor. The City chose to develop a future plan for Colorado Boulevard.

The study corridor is shown in **Figure 1** and extends along Colorado Boulevard from 27th Street/US14A near Interstate 90 (I90) Exit 14 to Colorado Loop near US Highway 85 (US85) and I90 Exit 17. The corridor study also includes four study intersections:

- Colorado Boulevard/US14A & 27th Street/US14A
- Colorado Boulevard & Heritage Drive
- Colorado Boulevard & Maitland Road
- Colorado Boulevard & Rainbow Road

The City of Spearfish has jurisdiction of Colorado Boulevard and 27th Street to the east and south of the Colorado Boulevard/US14A & 27th Street/US14A intersection, respectively. SDDOT has jurisdiction of Colorado Boulevard/US14A and 27th Street/US14A to the west and north of the Colorado Boulevard/US14A & 27th Street/US14A intersection, respectively. SDDOT owns and maintains the signals at the Exit 14 interchange and the Colorado Boulevard/US14A & 27th Street/US14A intersection.

At the time of the Colorado Boulevard Corridor Study, there was a study being conducted for the US85 corridor that included the intersection of Colorado Boulevard & US85. Recommendations for the intersection of Colorado Boulevard & US-85 are provided in the US85 Corridor Study.

Up until recently, Colorado Boulevard has largely served east-west through traffic.

East ↔ West

However, the corridor is beginning to serve as the primary means of access to developing areas along and south of the corridor.

1.1 Study Objectives



Determine
the improvements needed over the next 20-30 years.



Create
build alternatives for the corridor.



Establish
a timeline for the improvements.



Develop
a long-range plan for the corridor



Intersection	Study Intersection
1	Colorado Blvd & 27th St
2	Colorado Blvd & Heritage Dr
3	Colorado Blvd & Maitland Rd
4	Colorado Blvd & S Rainbow Rd

STUDY CORRIDOR

Figure 1



1.2 Study Process

A Study Advisory Team was organized to guide the study and provide incremental input and feedback at key study milestones. This team consisted of City of Spearfish staff, Lawrence County staff, and South Dakota Department of Transportation (SDDOT) staff across a variety of multimodal transportation disciplines.

A methods and assumptions (M&A) document was prepared at the onset of this Study to serve as a historical record of the study process, analysis methodology, dates, and decisions made by the study team representatives for the corridor study. The final signed version of the M&A document is provided in **Appendix A**.

This study used the following four-step process to develop long-range planning recommendations. The Study Advisory Team (SAT), public, and stakeholder involvement were all instrumental in a process that included one SAT workshop, two stakeholder meetings, and two public meetings. A summary of the four steps and relationship to chapters in this report, is provided in **Table 1**.

Table 1. Summary of Study Process and Applicable Report Sections

Step	Components	Applicable Report Sections
1	<p><u>Identify Transportation Issues and Needs</u></p> <ul style="list-style-type: none"> • Data collection • Analysis of existing and future No-Build conditions • Begin environmental screening of corridor • Public meeting #1 – gather feedback on issues and need 	Sections 3-4
2	<p><u>Develop Concepts</u></p> <ul style="list-style-type: none"> • SAT workshop – concept brainstorming • Develop, analyze, and refine concepts • Public meeting #2 – present build alternatives for feedback 	Section 5
3	<p><u>Develop Feasible Solutions for the Project</u></p> <ul style="list-style-type: none"> • Stakeholder meeting & community organization presentations – present build alternatives for feedback • Develop, analyze, and refine build alternatives 	Section 6-7
4	<p><u>Develop Recommendations</u></p> <ul style="list-style-type: none"> • Develop corridor study report • Develop environmental screening report 	Section 8-9

The purpose of this report is to summarize the planning level corridor study, document the build alternative refinement and evaluation process, and support the recommendations for future projects.

2.0 Public, Stakeholder, and Agency Participation

2.1 Study Website

A study website was hosted at <https://www.coloradoblvdcorridorstudy.com/> and was maintained throughout the study process. The purpose of the website was to provide information to the public regarding the status of the Study. Public meeting announcements, recorded presentations, meeting summaries, and all technical memorandums and reports were available for download through the Study website. The website also allowed the public to provide feedback electronically.

2.2 Public Meetings

Open house meetings were held to gather feedback from the public and stakeholders within the Study Area. The public meeting dates, times, and locations were advertised in the Black Hills Pioneer newspaper and the City of Spearfish and SDDOT social media accounts. Public meeting reports were created to summarize each public meeting and are provided in **Appendix B**. The date and topic of each public meeting is listed below.

Public Meeting #1 — February 3, 2023

The first public meeting introduced the Study to the public. The meeting topics included the Study's background, goals, schedule, existing conditions, and future needs.

Public Meeting #2 — August 24, 2023

The second public meeting presented the build alternatives, analysis, and the advantages and disadvantages of each.

2.3 Stakeholder Meetings

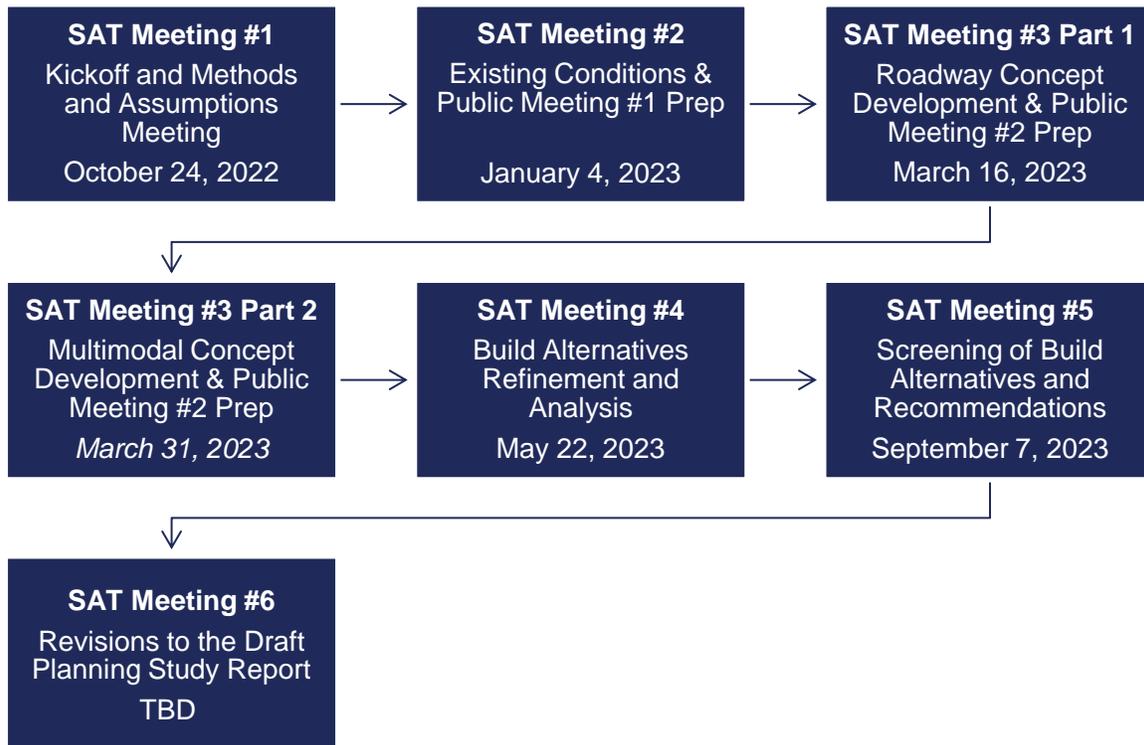
Stakeholder meetings were held in conjunction with the public meetings during the day of February 3, 2023 and August 24, 2023. Stakeholders were able to ask questions and provide verbal or written feedback. Any feedback received was documented and is summarized in the stakeholder meeting minutes in **Appendix B**.

Representatives from the following companies/organizations were present at the stakeholder meetings:

Auto Choice	Black Hills Pure	Carpet Buyers Outlet	Culligan Water	Elkhorn Ridge Development
Elkhorn RV Resort	Frog N Droz	Lantis Enterprises	Lawrence County Emergency Management	LodgeTS Tech
Master's Auto Detailing	Quik Signs	RecStation	Restore	Rice's Spearfish Canyon Motorsports
Riverfront Broadcasting	Roughlock Auto	Something Borrowed / SB Prop Rentals	Spearfish Ambulance	Spearfish School District
Storage	Tractor Supply / LJZ LLC	Transmission Specialists	Visit Spearfish	

2.4 Study Advisory Team Meetings

Meetings were held with the SAT periodically throughout the study timeline.



3.0 Existing Conditions and Future Needs

3.1 Existing Conditions and Future Needs Assessment Purpose

An important piece of the study was determining the future needs of the Colorado Boulevard corridor. This process was completed to identify those needs by taking inventory of the existing conditions including the regional roadway network, existing land use, accesses, traffic volumes, roadway section, right-of-way, roadway geometrics, major drainage structures, multimodal facilities, historical crash review, and existing and future no-build traffic operations.

3.2 Spearfish Background, Trends, and Goals

Spearfish is known for being an educational, agricultural, and commercial center within a beautiful natural setting in the Black Hills of South Dakota. Lying on the northern edge of the Black Hills and within close proximity to I90, the City has become a regional trade center. Spearfish has seen growth in their health care system, university, retail, office/personal service, and light manufacturing services due to their accessibility to I90 and the neighboring communities of the Black Hills and parts of northeast Wyoming and southeast Montana. According to the City of Spearfish Comprehensive Plan, the goal for their transportation network is to “promote safe and efficient opportunities for citizens to drive, bicycle, and walk to their desired destinations while preserving the small-town casual pace and atmosphere” (City of Spearfish, 2013)¹.

The City of Spearfish Comprehensive Plan¹ also states that Spearfish has a tiered set of priorities for the design of their streets:

1. Traffic volumes should take the first priority,
2. Non-vehicular travel second,
3. Overall cost third (including original construction, snow removal and surface maintenance),
4. On-street parking needs last

As shown in **Table 2**, Spearfish has grown by more than 20% on average for the past eight decades. In the last ten years, the City of Spearfish has outpaced the growth of Lawrence County and the state by roughly a factor of two.

¹ City of Spearfish. (2013, July 15). *envision Spearfish - The Comprehensive Plan of the City of Spearfish*. Retrieved from <https://www.cityofspearfish.com/DocumentCenter/View/364/Spearfish-Comprehensive-Plan-PDF>

Table 2. City of Spearfish Population Trends

Year	City of Spearfish		Lawrence County		South Dakota	
	Total	% Change	Total	% Change	Total	% Change
1950	2,775	---	16,648	---	652,740	---
1960	3,682	32.7%	17,075	2.6%	680,514	4.3%
1970	4,661	26.6%	17,453	2.2%	665,507	-2.2%
1980	5,251	12.7%	18,339	5.1%	690,768	3.8%
1990	6,966	32.7%	20,655	12.6%	696,004	0.8%
2000	8,608	23.6%	21,802	5.6%	754,844	8.5%
2010	10,494	21.9%	24,097	10.5%	814,180	7.9%
2020	12,201	16.3%	26,221	8.8%	892,717	9.6%
Average		23.8%		6.8%		4.7%

3.3 Regional Roadway Network

The study corridor is bordered by US14A to the west (near I90 Exit 14) and US85 to the east (near I90 Exit 17). Colorado Boulevard parallels I90 to the south as they both generally travel east-west for the length of the study corridor.

US85 connects the eastern part of Spearfish/I90 to Lead/Deadwood and eastern Wyoming. US14A converges with Colorado Boulevard between Spearfish Canyon Highway and 27th Street. The Exit 14/I90 interchange is a terminal point for US14A and is approximately 14 miles west of the Wyoming state line. US14A serves as an alternate route between the Cities of Spearfish, Lead/Deadwood, and Sturgis. US14A is a primary tourist route of the Northern Black Hills and a federally designated scenic byway as the route through scenic Spearfish Canyon. **Figure 2** illustrates the geographic context of these regional highways with respect to the study area.

According to the SDDOT 2020 Decennial Interstate Corridor Study, a potential interchange at the Rainbow Road underpass between Exit 14 and Exit 17 was evaluated for feasibility. A new Exit 16 interchange would enhance access to the Black Hills Airport and would be expected to reduce congestion at Exit 14, Exit 17, and Colorado Boulevard. Ultimately, a new Exit 16 interchange was not recommended at this time due to several key issues including adjacent development, the interchange potentially being within the airport’s runway protection zone, and other various environmental and ROW concerns. However, it was recommended that access, travel times, and vehicle-miles traveled (VMT) for areas north of I90 should be monitored (FHU, 2021)².

² FHU. (2021, September). *2020 South Dakota Decennial Interstate Corridor Study Phase Two Report*. Retrieved from https://dot.sd.gov/media/SDDOT%20ICS_Phase%202%20Report_final.pdf



REGIONAL ROADWAY NETWORK

Figure 2



3.4 Local Roadway Network

Colorado Boulevard is the only arterial roadway that extends from the western to eastern sides of the City of Spearfish. Using the functional classifications presented in the Spearfish Area Master Transportation Plan (MTP), four of the five major crossroads that intersect the study corridor have an arterial functional classification including 27th Street, Maitland Road, Rainbow Road, and US85. The only collector that intercepts the study corridor at present is Heritage Drive.

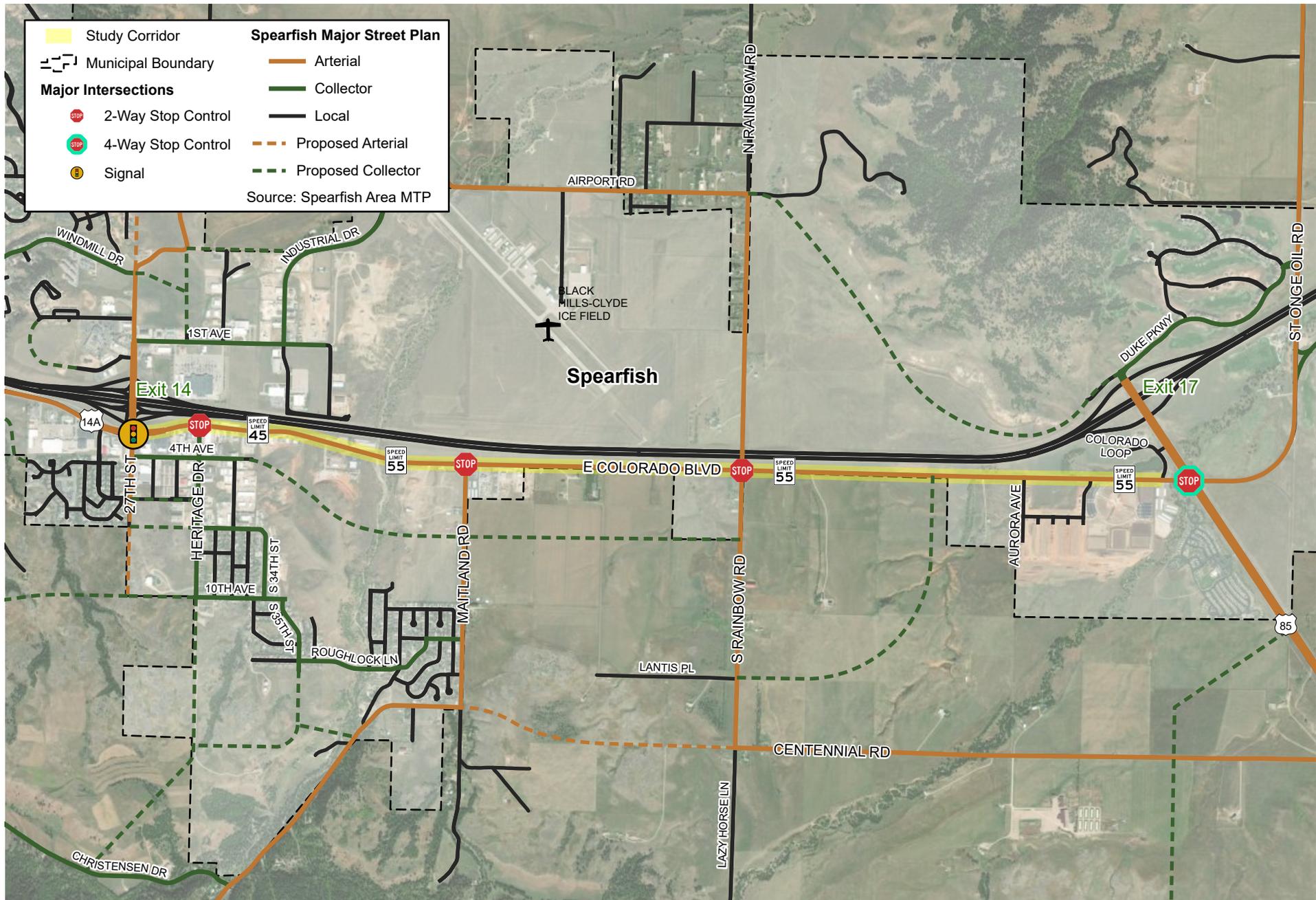
27th Street continues north and provides access to several hotels, restaurants, and retail stores and ultimately connects into Airport Road. 27th Street to the south dead ends at Aspen Drive adjacent to the Rolling Hills subdivision. Heritage Drive provides connectivity to many commercial and light industrial developments before transitioning to residential housing, such as the Green Acres subdivision. Maitland Road provides access to Mountain Shadow Estates and continues south into the hilly terrain of the Black Hills, eventually connecting with US14A near Deadwood. South Rainbow Road connects to Centennial Road, another arterial roadway, that also provides connectivity to US85. North Rainbow Road provides access to the airport and several rural residential developments.

At present, the intersection of Colorado Boulevard and 27th Street is the only signalized intersection on the study corridor. Prior to June 2022, the intersection of Colorado Boulevard and US85 was a two-way stop-controlled intersection and is now an all-way stop controlled intersection. The three Colorado Boulevard intersections at Heritage Drive, Maitland Road, and South Rainbow Road are all stop controlled on the respective minor street approach to Colorado Boulevard.

There are several proposed improvements to the nearby local roadway network in the City of Spearfish Area MTP including a connection between Mainland Road to Rainbow Road (project #29), an extension of New Lantis Place between Rainbow Road to Colorado Boulevard, and the paving of South Rainbow Road between Centennial Road to Colorado Boulevard (project #32), and an extension of Airport Road from North Rainbow Road to Exit 17 (project #26) (FHU, 2011)³.

Figure 3 illustrates the local roadway network including the functional classifications, intersection control types at the major intersections, and proposed roadway connectors.

³ FHU. (2011, July). *moveSpearfish - Spearfish Area Master Transportation Plan*. Retrieved from <https://www.cityofspearfish.com/DocumentCenter/View/1765/Spearfish-Area-Master-Transportation-Plan-PDF>



LOCAL ROADWAY NETWORK



Figure 3

3.5 Posted Speed

The posted speed limit along Colorado Boulevard is 55 mph but changes to 45 mph west of Maitland Road near False Bottom Creek. Stakeholders and the traveling public have conflicting opinions on whether this should remain a high-speed facility. The argument to lower the posted speed limit is the desire to make Colorado Boulevard a street that prioritizes local business access and to encourage motorists that are trying to make thru trips to use the interstate. There is also a strong desire from members of the community to make this a bicycle and pedestrian friendly route, and lower speeds would make for a less stressful pedestrian/bicycle experience. There was also public support to keep the speed limits 45 mph or higher in order to maintain the arterial roadway’s purpose of getting from “Point A to Point B”.

Studies show that most people use visual cues and a ‘feel’ for the road to determine their vehicle speed instead of the posted speed limit. The Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices (MUTCD) recommends that the posted speed limits are within 5 mph (plus or minus) of the 85th percentile speed. A speed study was completed along US14A and Colorado Boulevard and the results are compiled in **Table 3**.

Table 3. Vehicle Speed Study

Location	Posted Speed Limit	85 th Percentile Speed
US14A (Near Sandstone Hills Rd) ⁴	45	48
Colorado Blvd. (Near Heritage Drive) ⁵	45	41
Colorado Blvd. (One quarter-mile east of Maitland Road) ⁶	55	53
Colorado Blvd. (One half-mile east of Rainbow Road) ⁷	55	57

The results from the speed study generally support the current posted speed limits. As development along the corridor increases, this may change. The City plans to continue to monitor the 85th percentile speeds and lower the speed limits when the data supports the reduction in speed limits. The study advisory team discussed the desire for the posted speed limit to likely be around 40 to 45 mph once the corridor is fully developed.

⁴ SDDOT. Speed Study completed Wednesday, April 12, 2023 from 9:30 AM to 11 AM.

⁵ SDLTAP. Speed Study completed Thursday, May 25, 2023 from 8 AM to 8 PM.

⁶ SDLTAP. Speed Study completed Tuesday, May 23, 2023, at 11 AM to Wednesday, May 24, 2023, at 12 PM.

⁷ SDLTAP. Speed Study completed Tuesday, May 16, 2023, at 1 PM to Wednesday, May 17, 2023, at 10 AM.

3.6 Land Use and Proposed Development

As shown in **Figure 4**, the majority of the zoning adjacent to the study corridor is Highway Service Commercial, Heavy Industrial, and Agricultural. Both City of Spearfish and Lawrence County zoning are shown, because the majority of the land directly south of Colorado Boulevard between Maitland Road and Colorado Loop is outside of the City of Spearfish limits. The City of Spearfish has a 3-mile Joint Planning Jurisdiction with Lawrence County.

Commercial, industrial, residential, and mixed-use developments are currently being planned to the south and east of the corridor. Similar to how development has progressed surrounding the I90 Exit 14 interchange in the last twenty years, it is expected that the area to the south and east of Colorado Boulevard will transform into a hub of regional activity.

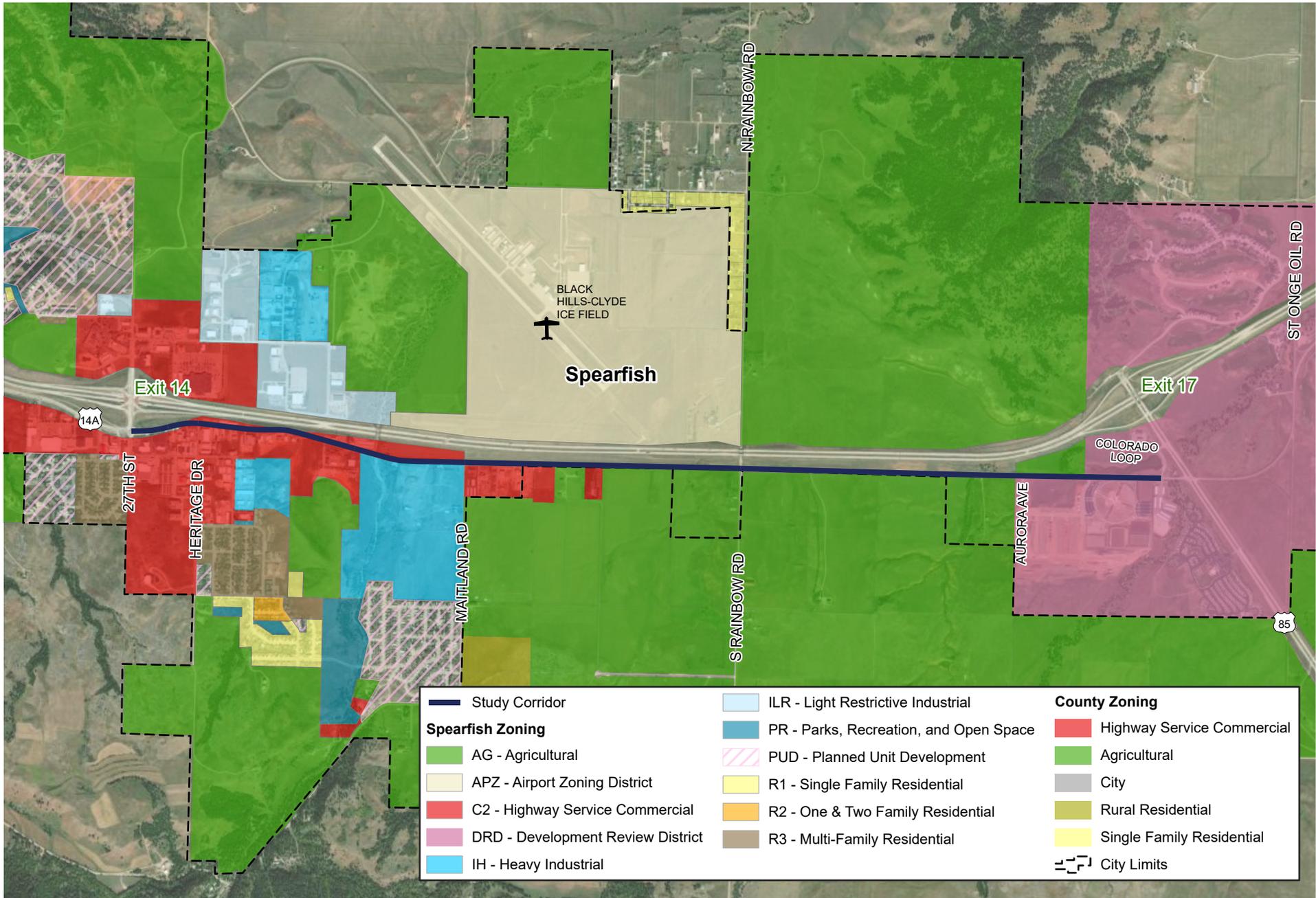
Proposed Development

Most of the land surrounding the study corridor is undeveloped, open land between Maitland Road and the Sky Ridge subdivision. Proposed and ongoing developments in the area include the following:

- Centennial Mountain Estates – Mix of single family residential, multi-family residential, and commercial
- Peaceful Pines – Assisted living and independent living facility
- Elkhorn Ridge – Mix of single family residential, multi-family residential, and commercial
- Monument Health – New multispecialty clinic
- Sky Ridge Development – Sports complex and single family residential
- False Bottom Addition
- Platinum Investments
- Sawyer Tap Room – A beer manufacturing warehouse and tap room

Land use compatibility, availability to water and sewer infrastructure, topography, and floodplains will all play a factor in the location, growth rate, density, and land use surrounding the study corridor. The City's overall goal for the area is for development to be a mix of land uses including a range of residential densities, commercial, and light industrial uses (City of Spearfish and Lawrence County, 2022)⁸.

⁸ City of Spearfish and Lawrence County. (2022, March 21). East Colorado Boulevard Area Land Use Study.



CITY OF SPEARFISH AND LAWRENCE COUNTY ZONING



Figure 4

Black Hills-Clyde Ice Airport Land Use Compatibility

Black Hills-Clyde Ice Field Airport is a public general aviation airport serving Spearfish, Lead, and Deadwood. The airport resides north of the Colorado Boulevard study corridor and I90 and is situated between Heritage Drive and Rainbow Road. The airport operates with three runways, one is asphalt and two are grass. The airport continues to grow as the Northern Black Hills region grows with a regular demand for new hangars and increased use by larger and faster aircraft (KLJ, 2020)⁹.

Currently Colorado Boulevard and I90 are within the approach runway protection zones (RPZ) for three of the existing runways. The RPZ is a trapezoidal land use area off the end of the runway that serves to enhance the protection of people and property on the ground in the event an aircraft lands or crashes beyond the runway end. New development discouraged within the RPZ includes new roads, structures and places of public assembly (KLJ, 2020). An aviation easement in the vicinity of Colorado Boulevard and Rainbow Road limits building heights based on the applicable conical surface of the easement and the specific ground elevation for where a building is to be constructed. Determination of allowable building height and land use compatibility requires an assessment performed by a registered land surveyor. The City would prefer commercial land uses over residential land use in this vicinity (City of Spearfish and Lawrence County, 2022). **Figure 5** presents the location of the airport runways, parcel, and RPZs.

Availability of City Services

The topography of the surrounding land controls how the area is provided with gravity sewer. An upgrade to the Elkhorn Ridge sewer lift station and force main system took place in 2022-2023 to add sewer capacity to the area since the current system is nearing capacity. The East Colorado Boulevard Area Land Use Study provides more details for where gravity sewer is possible between Maitland Road and US85. Where gravity sewer is not possible, rural land uses will be encouraged for the near term unless alternate methods for wastewater treatment are provided.

The present water delivery system can support growth and development for the next several years. In the next couple years, it is in the City's capital improvement plan to construct a new well and water storage reservoir.

Areas identified in the East Colorado Boulevard Area Land Use Study as being able to support urban and suburban land use patterns include:

- Immediately east of Maitland Road and south of Colorado Boulevard
- Quarter mile east of Rainbow Road to the west boundary of the Sky Ridge subdivision
- Portions of the Centennial Mountain Estates north of I90 and east of Rainbow Road

⁹ KLJ. (2020, December). Black Hills Airport – Clyde Ice Field Airport Master Plan.



3.7 Access Inventory

Access is a necessary part of the roadway network, but it also introduces conflict and friction into the traffic stream. Arterial roadways, such as Colorado Boulevard, provide the greatest function of mobility and therefore should be the most restrictive in terms of providing access to adjacent properties. Access management can help identify opportunities to reduce or consolidate access points along a corridor in order to improve the flow of traffic and reduce the number of potential vehicular collisions. The National Cooperative Highway Research Program (NCHRP) Report 420 outlines research findings that demonstrate the impacts of access to crash potential and corridor travel speeds. The research indicates that accident rates (accidents per million vehicle miles traveled) generally increased as access density increased. Signalized access density was one of the more influential factors. In urban and suburban areas, the research also indicated that the accident rate for access densities of more than 60 per mile was more than 2.5 times higher than the accident rate for access densities of fewer than 20 per mile (Gluck & Levinson, 1999)¹⁰.

Colorado Boulevard is not managed by SDDOT and therefore the City of Spearfish access spacing guidelines govern. **Table 4** summarizes the City of Spearfish’s access spacing standards contained within the Spearfish Area MTP for arterial roadways.

Table 4. Spearfish Access Spacing Standards

Functional Classification	Distance between Full Movement Accesses	Distance between Limited Movement Accesses
Arterial	¼ mile (1,320 feet)	660 feet

Source: Spearfish Area Master Transportation Plan’s Table 9

Additional guidance found within the MTP specific to arterials has been transcribed below.

- Ideally, accesses [to arterial roadways] should be limited to only arterial and collector cross-streets.
- Intersections with the potential for eventual signalization should be spaced at one-quarter-mile intervals.
- The location of any access should maintain a minimum spacing of 500 feet with any other access or intersection subject to allowance for proper vehicular turn lane storage requirements.
- Single family homes will not be allowed to front onto an arterial.

¹⁰ Gluck, J., & Levinson, H. (1999). *NCHRP Report 420 - Impacts of Access Management Techniques*. Washington, D.C.: TRB.

Figure 6 identifies the accesses within the study area and whether they meet City of Spearfish minimum access spacing, and access density criteria listed in **Table 4**. Most accesses along Colorado Boulevard do not meet the City of Spearfish’s access density standards.

Figure 7 breaks the corridors down into smaller segments and shows the access density in accesses per mile. The highest access density can be found on the western end of the corridor between 27th Street and Heritage Drive.

Intersection Functional Area

Another way to look at access spacing near major and minor intersections is to determine if driveways are within the intersection functional area. The functional area of an intersection includes both the physical area and influence area (turn lanes, channelization and driver decision distance). The functional area of the four study intersections was reviewed to identify locations for potential access management opportunities.

Upstream functional distances account for:

- Distance traveled during a perception-reaction time, d1
- Deceleration distance while the driver maneuvers to a stop, d2
- Queue storage, d3

The downstream functional distance generally accounts for stopping sight distance where a driver can pass through an intersection and then ascertain situations where they may need to stop due to downstream intersection conflicts.

An overlap of adjacent intersection functional areas reflects a situation where a driver needs to perceive and react to multiple events and potential conflicts with other vehicles. The SDDOT Road Design Manual references AASHTO, stating that “driveways should not be situated within the functional boundary of at-grade intersections”. This may not always be possible if alternate access is not available or cannot be provided at a feasible cost. When access within the functional area cannot be avoided, movements should be restricted to right-in/right-out only.

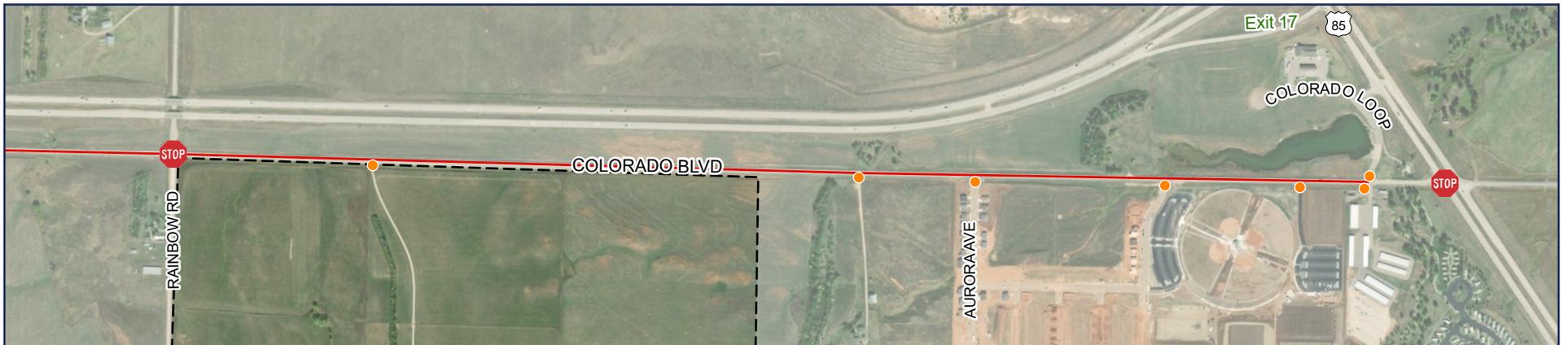
The following criteria was used to determine functional areas of intersections:

- Signalized intersections:
 - Upstream functional area reviewed using d1, d2, and d3.
 - Downstream functional area reviewed using stopping sight distance.
- Unsignalized intersections:
 - Upstream functional area is reviewed using the d1 and d2 (assumed no queues, d3).
 - Downstream functional area reviewed using the stopping sight distance and driveway influence distance (NCHRP Project 3-52).

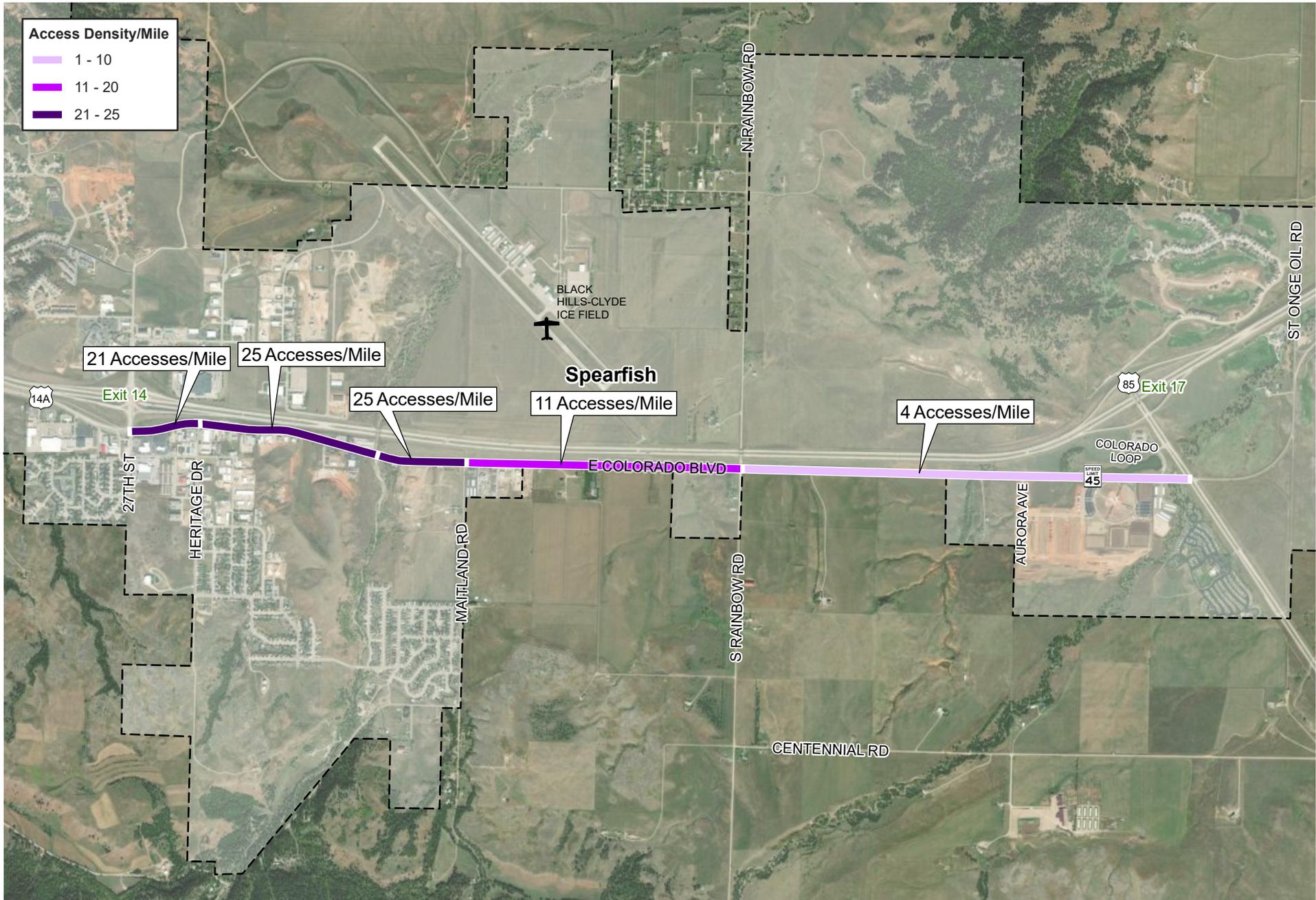
Figure 8 illustrates the upstream and downstream intersection functional areas of each of the study intersections. Alternative means of providing access to driveways within the intersection functional areas should be considered for the following locations, such as providing access via

the minor cross street or consolidating accesses via shared driveways. The following locations on the corridor have accesses which are contained within the intersections' functional areas:

- 27th Street – Two accesses to the east of the intersection.
- Heritage Drive – Two accesses to the west and three accesses to the east of the intersection.
- Maitland Road – Two accesses to the west and two accesses to the east of the intersection.



ACCESS INVENTORY
WITH CITY OF SPEARFISH ACCESS SPACING STANDARDS
 Figure 6



ACCESS DENSITY



Figure 7



- Upstream Intersection Functional Area
- Downstream Intersection Functional Area
- Study Intersection
- Access within Functional Area of Intersection

STUDY INTERSECTION FUNCTIONAL AREAS

Figure 8



0 250 Feet



3.8 Existing Traffic Volumes and Roadway Sections

The existing roadway section is two 11-foot lanes. A raised median divides the westbound and eastbound lanes for 600 feet west and east of the intersection of Colorado Boulevard and 27th Street. **Figure 9** visually summarizes the 2022 average daily traffic volumes throughout the Study Area.

The average annual traffic volumes along Colorado Boulevard within the study area range from 3,300 vehicles per day (vpd) on the east end to 8,800 vpd on the west end of the corridor. The highest volume cross street is 27th Street north of Colorado Boulevard with over 12,700 vpd, followed by US85 (6,600 vpd), Heritage Drive (3,800 vpd), Maitland Road (1,900 vpd), and Rainbow Road (500 vpd).

3.9 Right-of-Way

The majority of the existing right-of-way ranges from 82 feet to 100 feet wide along the primary study corridor. **Figure 10** displays the varying right-of-way widths throughout the Study Area.

3.10 Existing Geometric Review

Horizontal curves, intersection sight distance, and intersection skews were reviewed as part of the existing geometric review. The main focus for this review were the major intersections and the horizontal alignment along Colorado Boulevard within the study area. Ideally, the design speed is 5 mph above the posted speed limit but can be the same as the posted speed limit. The posted speed limit was used as the design speed in the existing geometric review since it signifies the bare minimum geometric design criteria.

Horizontal and Vertical Curves

The posted speed limit is 45 mph between 27th Street and False Bottom Creek (west of Maitland Road) and 55 mph for the remainder of the eastern half of the corridor. Assuming 4% superelevation (typical for an urban roadway), the minimum radius of a horizontal curve at 45 mph is 711 feet and the minimum radius of a horizontal curve at 55 mph is 1190 feet. The curve numbers shown in **Table 5** correspond with the horizontal curves represented in **Figure 11**. Assuming the horizontal curves are superelevated appropriately for the design speed, all horizontal curvature meets the minimum radius criteria.

Table 5. Horizontal Curves

Curve Number	Station Range	Radius (ft)	Design Speed (mph)	Minimum Radius (E _{max} =4%)	Minimum Radius Met?
C1	119+88 to 133+96	2235	45	711	Yes
C2	137+63 to 141+83	1270	45	711	Yes
C3	150+43 to 153+67	2750	45	711	Yes
C4	155+63 to 159+69	1290	45	711	Yes
C5	178+41 to 182+85	1910	55	1190	Yes

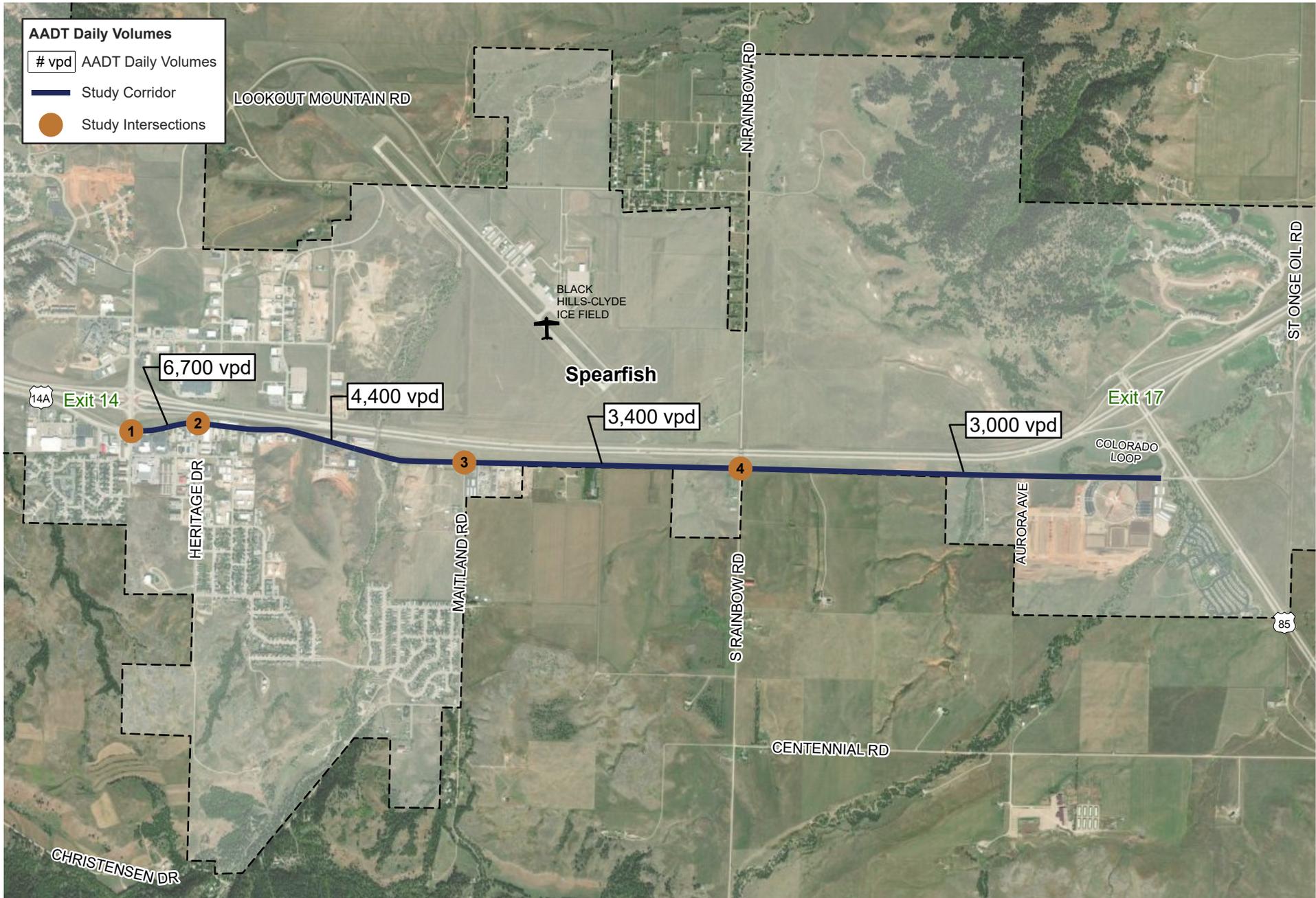
The K-value of a vertical curve represents the horizontal distance along which a 1% change in grade occurs on the vertical curve. It expresses the abruptness of the grade change in a single value and represents whether that vertical curve provides adequate stopping sight distance. As shown in **Table 6**, there are several vertical curves that do not currently meet the minimum K-value for their appropriate design speeds including four sag curves and one crest curve.

Table 6. Vertical Curves

Vertical Curve Number	Crest/Sag	Point of Vertical Intersection (PVI) Station	Vertical Curve Length (ft)	Design Speed (mph)	Actual K	Minimum K	Meet Minimum K?
VC1	Sag	124+29.18	171	45	74	79	N
VC2	Crest	127+42.12	316	45	101	61	Y
VC3	Sag	137+01.85	1094	45	626	79	Y
VC4	Sag	148+67.62	236	45	69	79	N
VC5	Crest	155+35.79	587	45	180	61	Y
VC6	Crest	175+38.31	200	55	925	114	Y
VC7	Crest	188+64.22	851	55	647	114	Y
VC8	Crest	214+59.35	200	55	231	114	Y
VC9	Sag	237+09.52	400	55	152	115	Y
VC10	Crest	245+00.03	584	55	144	114	Y
VC11	Sag	249+16.99	200	55	115	115	Y
VC12	Sag	254+22.59	326	55	71	115	N
VC13	Crest	260+92.56	615	55	61	114	N
VC14	Sag	267+47.10	538	55	193	115	Y
VC15	Sag	274+08.77	328	55	122	115	Y
VC16	Crest	284+40.04	784	55	985	114	Y
VC17	Sag	304+59.28	182	55	99	115	N

Intersections

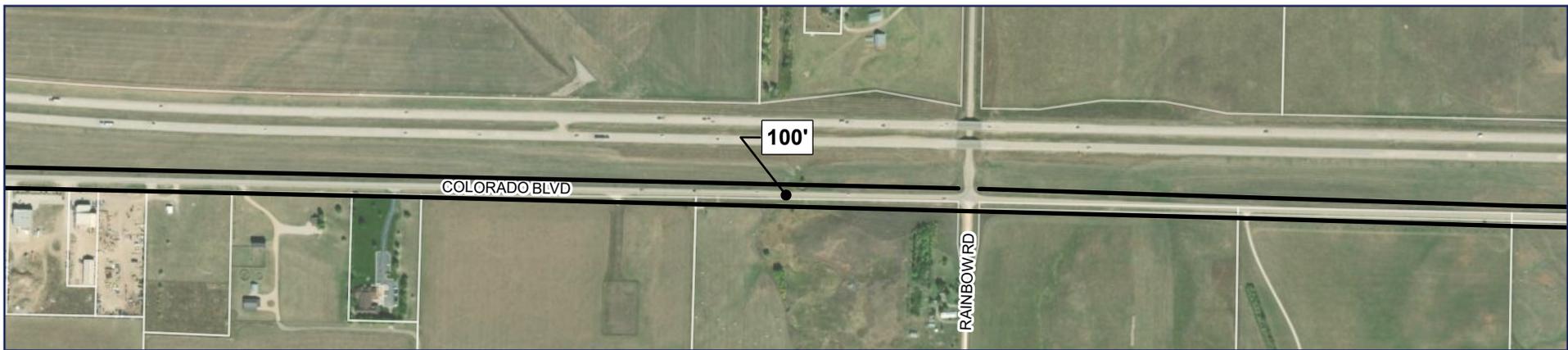
Departure sight triangles at intersections should be clear of obstructions (building, parking, trees, etc) and the intersection of the two streets optimally should be close to a right angle. Departure sight triangles were reviewed at each of the five study intersections. However, no horizontal sight obstructions were identified on any of the legs of the intersections.



EXISTING TRAFFIC VOLUMES



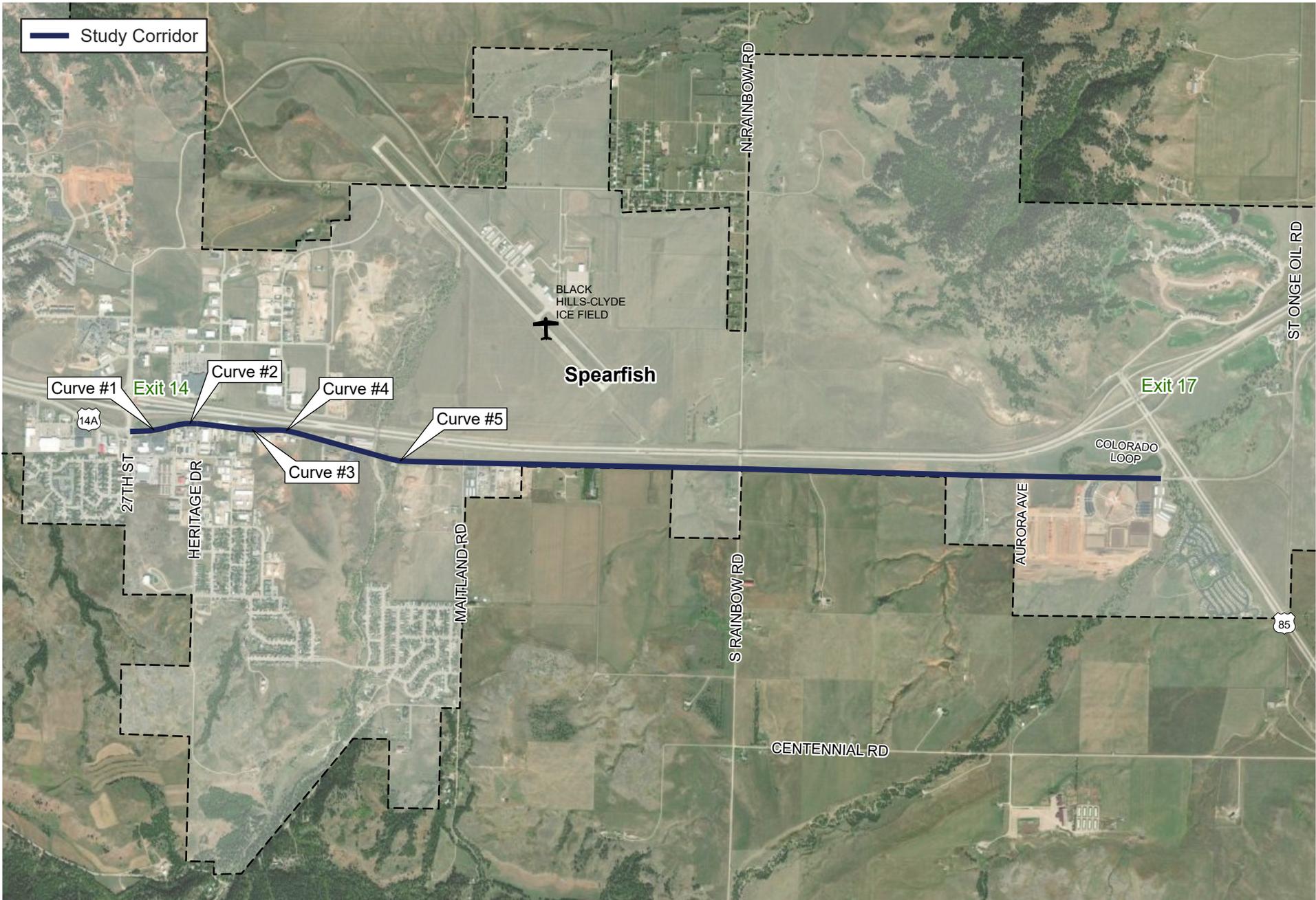
Figure 9



EXISTING RIGHT-OF-WAY WIDTHS



Figure 10



Study Corridor

Curve #1

Exit 14

Curve #2

Curve #4

Spearfish

Exit 17

Curve #5

Curve #3

COLORADO LOOP



HORIZONTAL CURVES

Figure 11

\\SXF-SRV01\ENGIN\GIS\PROJECTS\SDDOT\COLORADOBLVD_STUDY_SPEARFISH_10354767\MAP_DOCS\COLORADOBLVD_STUDY_SPEARFISH.APRX DATE: 12/1/2023

3.11 Multimodal Facilities

The Colorado Boulevard study corridor has minimal multimodal facilities within the extents of the Study Area. As shown in **Figure 12**, the Spearfish recreation path, neighborhood sidewalks, and roadway with adequate shoulder width for bicyclists exist outside of and on the outer extents of the Study Area.

Recreation Path

A recreation path has been built from Spearfish Canyon Road along Colorado Boulevard to the Exit 14 interchange. From the Exit 14 interchange, the recreation path continues north to 1st Avenue and ends across the street from Walmart. The recreation path currently lacks connectivity along Colorado Boulevard between Exit 14 and Exit 17.

Surveys, conducted as part of the Spearfish Parks and Recreation Master Plan, identified the recreation path as the most used and most preferred parks and recreation asset in Spearfish. Extension of the recreation path is also listed as a priority in the Spearfish Comprehensive Plan to be constructed “as part of city capital projects or private development proposals”. According to the Spearfish Parks and Recreation Master Plan, there is a desire to extend the path for the entire length of the Colorado Boulevard study corridor. There is also a planned recreation path extension to provide connectivity between the recreation path along Colorado Boulevard and Green Acres and the Mountain Shadows at False Bottom Creek (City of Spearfish Parks, Recreation, and Forestry Department, 2022)¹¹.

Sidewalks

There are no current sidewalks along the Colorado Boulevard study corridor. However, there are several adjacent collector and local roadways that have sidewalks.

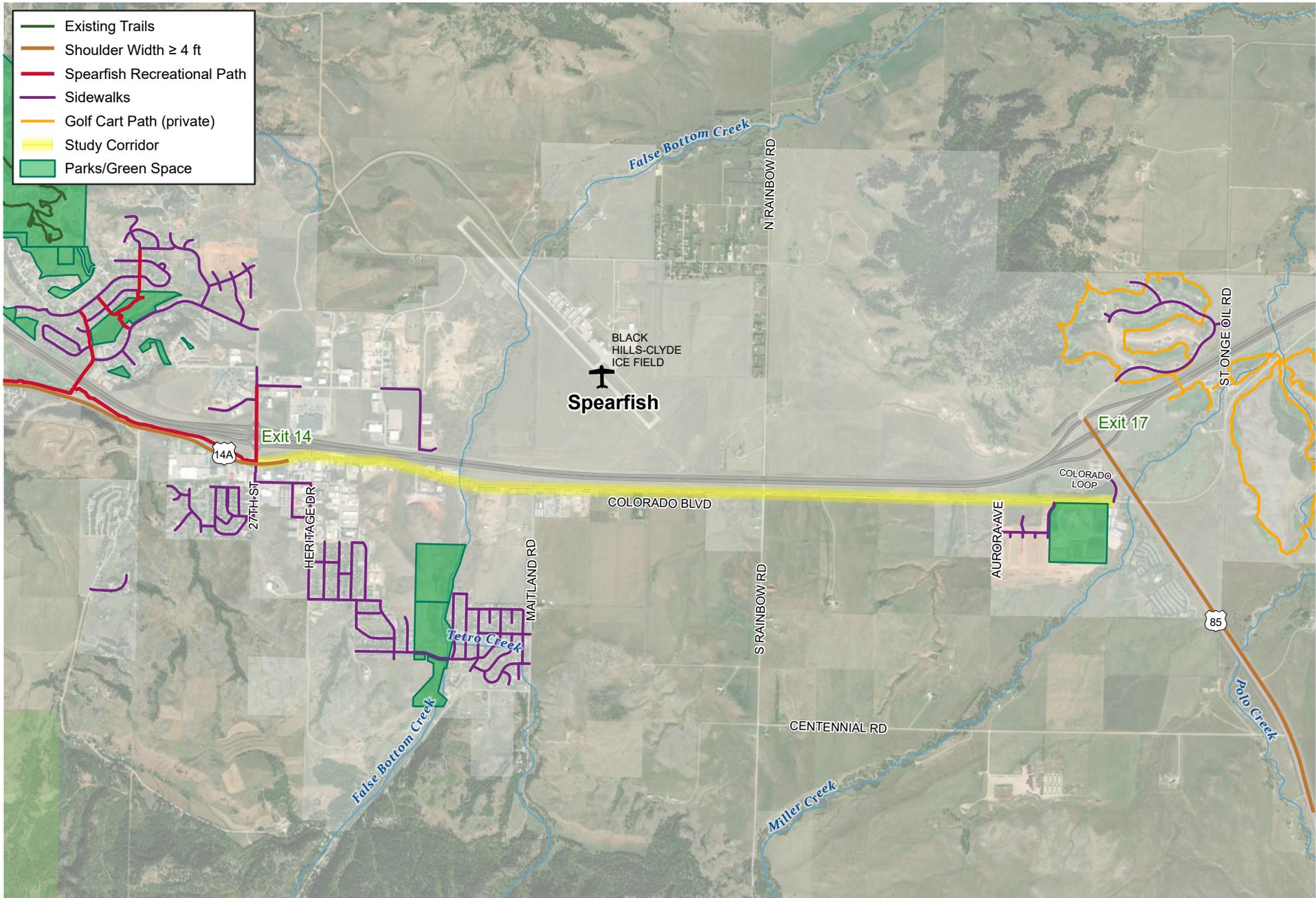
Transit

The Spearfish and greater Black Hills area is served by Prairie Hills Transit (PHT). There is a future transit park-n-ride location planned for north of the Exit 17 interchange. With the wide geographic spread of Spearfish, PHT is looking at building a second transit facility/depot/fuel station near Walmart (on the north side of the interstate near Exit 14) in the next three to five years. The current PHT transit building is near Exit 8 and also contains a childcare facility. PHT believes a fixed route loop will be justified along Colorado Boulevard in the next three to five years. According to PHT, they primarily serve younger families without a second car, children that need to be taken from school to various activities, and seniors.

¹¹ City of Spearfish Parks, Recreation, and Forestry Department. (2022). *City of Spearfish Parks and Recreation Master Plan 2022-2032*. Retrieved from <https://www.cityofspearfish.com/DocumentCenter/View/2076/Parks-and-Recreation-Master-Plan>

Shoulders

Shoulders should be a minimum of four feet to accommodate bicycle use. The majority of the Colorado Boulevard study corridor does not have any shoulder at present, requiring cyclists to travel in the major travel lanes. There is a six-foot shoulder 600 feet east of the Colorado Boulevard and 27th Street intersection.



3.12 Existing Utilities

Existing utilities are present on both sides of the Colorado Boulevard corridor. Utility owners include the following:

- City of Spearfish – Water & Sewer
- Montana Dakota Utilities – Natural Gas
- WBI Energy Transmission – Natural Gas
- Bluepeak – Communications
- Lumen – Communications
- Midcontinent - Communications
- South Dakota Network – Communications
- Black Hills Energy – Power
- Butte Electric – Power

Utility maps were provided by the utility owners and are included in **Appendix C**.

Public Utilities

A 12-inch water main exists on the south side of Colorado Boulevard sourced from the City of Spearfish Green Acres tank two miles southwest of Maitland Road. The water main is located along the south side of the road between 27th Street and west of Heritage Drive, then crosses to the north side of the road to west of False Bottom Creek, and then remains on the south side of the road between False Bottom Creek and US85.

Gravity sewer runs from east to west between Maitland Road and 27th Street. The sewer is located along the south side of the road between Heritage Drive and Maitland Road and the north side of the road between 27th Street and Heritage Drive. All of Elkhorn Ridge and Sky Ridge sewer flow is conveyed by gravity sewer to a city owned and operated lift station located between the Sky Ridge Sports Complex and Miller Creek. From here, the flow is pumped uphill in two six-inch force mains west to Maitland Road where it then returns to a gravity flow condition. In 2023, the City of Spearfish upgraded the Elkhorn Lift Station and install a 16" PVC force main on the north side of Colorado Boulevard between the lift station and Maitland Road.

Montana-Dakota Utilities (Natural Gas)

Montana-Dakota Utilities (MDU) owns several natural gas mains within the corridor. MDU's gas mains range in size from 2-inch to 4-inch and parallel on the south side of the road except at roadway crossing locations. The gas main from Maitland Road to approximately 2,000 feet to the west of Maitland Road along the ROW was relocated +/- 20 feet to the south to avoid contact with the city's new sewer. That has not been updated in the GIS maps provided in **Appendix C**. MDU plans to install a connection between their 4" main approximately 3,000 feet west of Rainbow Road to their 4-inch main approximately 2,800 feet east of Rainbow Road.

WBI Energy Transmission (Natural Gas)

WBI Energy Transmission owns a 4-inch gas transmission line that runs parallel to Colorado Boulevard starting at the south Spearfish border station approximately 1,100 feet east of Heritage Drive and then turns south approximately 900 feet east of the station.

Midcontinent Communications (Communications)

Midcontinent has communication lines throughout the corridor study area. However, map books of high enough quality were not able to be obtained from the owner.

Lumen (Communications)

Lumen owns several communication lines that parallel Colorado Boulevard for the entire north side of the roadway and for portions of the south side of the roadway between Maitland Road and Rainbow Road.

Bluepeak (Fiber Optic and Coaxial Cable Communications)

Bluepeak owns a fiber optic and coaxial cable communication line that parallels Colorado Boulevard on the north or south side of the road.

South Dakota Network (Communications)

South Dakota Network (SDN) owns an underground fiber optic cable that runs between I90 and the Colorado Boulevard corridor east of 27th Street. SDN also owns fiber that is located west of the US85 corridor and then crosses US85 near the Colorado Boulevard and US85 intersection.

Black Hills Energy (Power)

Black Hills Energy (BHE) owns an overhead and underground power distribution line that runs intermittently on the south side of Colorado Boulevard.

Butte Electric (Power)

Butte Electric owns an underground power distribution line that parallels the south side of Colorado Boulevard.

3.13 Major Drainage Structures

There are three major drainage structures on Colorado Boulevard including the following:

- False Bottom Creek – 0.3 miles west of the Maitland Road
- Tetro Creek – 0.2 miles west of Rainbow Road
- Miller Creek – 0.1 miles west of US85

As shown in **Figure 13**, the False Bottom Creek structure (Str. No. 41-126-089) is a 93-foot continuous concrete bridge with a width of 34.7 feet. This bridge was built in 1978 to replace the original bridge built in 1934. The bridge is a three-span bridge with steel pile supported abutments, and the center supports are pier walls supported on steel pile. This structure is listed in fair condition in the latest inspection report with only minor deficiencies.

Based on the current width, the False Bottom Creek bridge would not accommodate additional lanes of travel if the roadway needed additional capacity in the future. This structure could be widened by removing one or both barriers and a portion of the deck to a length needed to lap reinforcing steel to the new section width. The existing deck is reported in good condition; therefore, after the widened deck is in place, a concrete deck overlay can be placed over the entire deck to cover the existing deck and preserve it and also increase the friction coefficient of the deck surface. The piers would have new steel pile driven in line with the existing pier walls. Dowel bars would be drilled into the existing piers to tie the new construction and the pier walls would be extended to the needed limits to support the deck.



Figure 13. False Bottom Creek Bridge – South Elevation Looking North

The Tetro Creek structure is a twin 8-foot by 8-foot box culvert with a width of 32 feet. It is assumed to have been installed during the original construction of Colorado Boulevard. It is recommended that this box culvert structure be replaced due to age.

As shown in **Figure 14**, the Miller Creek structure (Str. No. 41-155-090) is a 23-foot existing twin 10-foot by 10-foot box culvert with a width of 32 feet. The structure is assumed to have been installed during the original construction of Colorado Boulevard. From the latest inspection report the box culvert has a poor inventory rating. The SDDOT and City of Spearfish have a structure replacement project programmed in the 2027 STIP with the assistance of federal funding.



Figure 14. Miller Creek Box Culvert – South Elevation Looking North

3.14 Environmental Data

Threatened and Endangered Species

Trees that serve as habitat for the endangered northern long-eared bat (NLEB) may be present within the study area. Bridges within the study area may also serve as suitable habitat for the NLEB. A field habitat review will need to be completed and consultation with the U.S. Fish and Wildlife Service should be conducted.

Archaeological/Historical Properties

One historic property listed as eligible for listing on the National Register of Historic Places (NRHP) exists within the study area. Additionally, portions of the Frawley Ranch National Historic Landmark are present on the east end of the study area. Large portions of the corridor's study area have not been previously surveyed. A survey should be conducted to determine if there are any unidentified archaeological/historic properties within the area. Consultation with SD State Historic Preservation Office should occur once impacts to these properties are known.

Wetlands and Other Waters of the U.S.

A desktop delineation found nine wetlands within the study area, totaling 41 acres. Three stream crossings also exist within the project and include approximately 2 acres and 3,912 linear feet (LF) of stream. Impacts to wetlands or other waters are likely and field delineations should be completed to determine the full extent of all wetlands and their boundaries once further project details are known. If impacts occur to wetlands or streams, a U.S. Army Corps of Engineers (USACE) Section 404 Permit may be required.

Floodplain

Federal Emergency Management Agency (FEMA) floodplain exists within the study area. Once details for planned projects are developed, a qualified hydraulic staff should review the plan sets to determine if impacts to the floodplain would occur. Additional coordination with the floodplain administrator or FEMA may be required.

The environmental screening report, provided in **Appendix D**, includes maps of the study corridor's surrounding hydrography, spills data, desktop delineated resources, bridges, structures, previous cultural survey areas, and historic designation boundaries.

3.15 No-Build Traffic Operations Summary

A summary of the existing and future no-build traffic operational analysis is provided in the following subsections. Refer to the No-Build Traffic Operations Memo provided in **Appendix E** and the Traffic Forecast Memo provided in **Appendix F** for further information.

Intersection and Corridor Level of Service Methodology

Traffic operations analyses for project area intersections and corridor segments were performed in accordance with methodologies defined in the study Methods & Assumptions (M&A) document. The measure of effectiveness (MOE) used for this analysis is Level of Service (LOS), which is a qualitative assessment of a highway's operating conditions and relates to a measurement reflecting the relative ease of traffic flow on a scale of A (best) through F (worst). The Highway Capacity Manual (HCM) defines the ranges for LOS, by facility type, as summarized in **Table 7** and **Table 8**.

Table 7: Intersection LOS Thresholds

LOS	Intersection Delay per Vehicle (sec/veh)	
	Signalized Intersections	Two-Way Stop-Control*, All-Way Stop-Control, and Roundabouts
A	≤ 10	≤ 10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	>25-35
E	> 55-80	> 35-50
F	Demand exceeds capacity; >80	Demand exceeds capacity; >50

Source: Transportation Research Board, HCM7.

*Two-way stop-control LOS reflects worst-case stop-controlled approach.

Table 8: Two Lane Highway LOS Thresholds

LOS	Follower Density (followers/mi/ln)	
	Higher-Speed Highways Posted Speed Limit ≥ 50 mi/h	Lower-Speed Highways Posted Speed Limit ≤ 45 mi/h
A	≤ 2.0	≤ 2.5
B	> 2.0 – 4.0	> 2.5 – 5.0
C	> 4.0 – 8.0	> 5.0 – 10.0
D	> 8.0 – 12.0	>10.0 – 15.0
E	> 12.0	> 15
F	Demand exceeds capacity	

Source: Transportation Research Board, HCM7.

Traffic Volumes

Existing condition traffic volumes reflect seasonally adjusted 24-hour daily and 12-hour peak hour traffic counts collected on October 6, 2022 (intersection counts), and October 5 – October 11, 2022 (Colorado Boulevard segment counts).

The traffic forecast development process followed methodologies outlined in *NCHRP 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design*, and included:

1. Determine background traffic growth to account for:
 - a. Pass-through traffic
 - b. Traffic growth to/from existing development along the corridor
2. Determine future development traffic along the corridor and surrounding area
 - a. Estimate future development trip generation
 - b. Identify planning-level trip distribution and assignment for the study corridor
 - c. Compare with historical study traffic patterns and adjust as needed to blend for consistency
3. Balance and smooth traffic volumes across analysis intersections along Colorado Boulevard

Additional information on the forecasting process is available in the *Colorado Boulevard Corridor Study Traffic Forecasts Technical Memo*. Build condition volumes used in the analysis are summarized in **Appendix F**. Existing, 2035, and 2050 daily segment volumes are summarized in **Figure 15**.

2022 Existing Condition Analysis

Existing condition operational results are summarized in **Table 9** and **Table 10**.

Table 9: Intersection Operations – 2022 Existing Conditions

Corridor	Crossroad	Intersection Control	Measure	AM Delay / LOS	PM Delay / LOS
Colorado Boulevard	27 th Street	Signalized	Overall:	31.7 / C	<u>35.3 / D</u>
	Heritage Drive	TWSC	Overall: (WCSC):	8.4 / A (26.5 / D)	5.2 / A (21.8 / C)
	Maitland Road	TWSC	Overall: (WCSC):	3.3 / A (12.2 / B)	2.3 / A (12.8 / B)
	Rainbow Road	TWSC	Overall: (WCSC):	1.7 / A (11.5 / B)	1.8 / A (10.8 / B)
	US 85	AWSC	Overall:	10.6 / B	10.6 / B

Cells noted in **Orange Bold Underline** correspond to where LOS does not meet acceptable thresholds.

Table 10: Segment Operations – 2022 Existing Conditions

Corridor	Crossroads	Direction	AM Follower Density / LOS	PM Follower Density / LOS
Colorado Boulevard	27 th Street to Heritage Drive	Eastbound	5.8 / C	6.1 / C
		Westbound	5.2 / C	4.5 / B
	Heritage Drive to Maitland Road	Eastbound	2.2 / A	2.9 / B
		Westbound	1.9 / A	2.3 / A
	Maitland Road to Rainbow Road	Eastbound	1.1 / A	0.9 / A
		Westbound	0.5 / A	1.2 / A
	Rainbow Road to US 85 Segment 1	Eastbound	1.2 / A	0.8 / A
		Westbound	0.5 / A	1.2 / A
	Rainbow Road to US 85 Segment 2	Eastbound	0.9 / A	0.9 / A
		Westbound	0.4 / A	1.0 / A
	Rainbow Road to US 85 Segment 3	Eastbound	1.2 / A	0.9 / A
		Westbound	0.6 / A	1.3 / A

2035 No-Build Condition Analysis

2035 No-Build condition operational results are summarized **Table 11** and **Table 12**.

Table 11: Intersection Operations – 2035 No-Build Conditions

Corridor	Crossroad	Intersection Control	Measure	AM Delay / LOS	PM Delay / LOS
Colorado Boulevard	27 th Street	Signalized	Overall:	<u>37.6 / D</u>	<u>61.0 / E</u>
	Heritage Drive	TWSC	Overall: (WCSC):	<u>100.6 / F</u> <u>(569.5 / F)</u>	<u>97.4 / F</u> <u>(815.9 / F)</u>
	Maitland Road	TWSC	Overall: (WCSC):	8.8 / A (55.4 / F)	8.8 / A (94.0 / F)
	Rainbow Road	TWSC	Overall: (WCSC):	<u>35.1 / D</u> <u>(134.9 / F)</u>	<u>67.2 / E</u> <u>(331.4 / F)</u>
	US 85	AWSC	Overall:	19.8 / C	<u>28.0 / D</u>

Cells noted in Orange Bold Underline correspond to where LOS does not meet acceptable thresholds.

Table 12: Segment Operations – 2035 No-Build Conditions

Corridor	Crossroads	Direction	AM Follower Density / LOS	PM Follower Density / LOS
Colorado Boulevard	27 th Street to Heritage Drive	Eastbound	<u>15.8 / E</u>	<u>16.0 / E</u>
		Westbound	<u>11.6 / D</u>	<u>16.3 / E</u>
	Heritage Drive to Maitland Road	Eastbound	<u>11.4 / D</u>	<u>11.4 / D</u>
		Westbound	7.2 / C	<u>13.2 / D</u>
	Maitland Road to Rainbow Road	Eastbound	6.3 / C	5.2 / C
		Westbound	3.3 / B	7.5 / C
	Rainbow Road to US 85 Segment 1	Eastbound	4.5 / C	3.3 / B
		Westbound	2.1 / B	5.1 / C
	Rainbow Road to US 85 Segment 2	Eastbound	4.0 / B	3.0 / B
		Westbound	2.0 / A	4.9 / C
	Rainbow Road to US 85 Segment 3	Eastbound	4.6 / C	3.5 / B
		Westbound	2.3 / B	5.5 / C

Cells noted in Orange Bold Underline correspond to where LOS does not meet acceptable thresholds.

2050 No-Build Condition Analysis

2050 No-Build condition operational results are summarized in **Table 13** and **Table 14**.

Table 13: Intersection Operations – 2050 No-Build Conditions

Corridor	Crossroad	Intersection Control	Measure	AM Delay / LOS	PM Delay / LOS
Colorado Boulevard	27 th Street	Signalized	Overall:	<u>142.2 / F</u>	<u>230.4 / F</u>
	Heritage Drive	TWSC	Overall: (WCSC):	<u>730.4 / F</u> <u>(5555.4 / F)</u>	<u>N/A</u>
	Maitland Road	TWSC	Overall: (WCSC):	<u>183.5 / F</u> <u>(1378.2 / F)</u>	<u>216.3 / F</u> <u>(2827.9 / F)</u>
	Rainbow Road	TWSC	Overall: (WCSC):	<u>N/A</u>	<u>1288.1 / F</u> <u>(5026.8 / F)</u>
	US 85	AWSC	Overall:	<u>74.0 / F</u>	<u>146.2 / F</u>

Cells noted in Orange Bold Underline correspond to where LOS does not meet acceptable thresholds.

Table 14: Segment Operations – 2050 No-Build Conditions

Corridor	Crossroads	Direction	AM Follower Density / LOS	PM Follower Density / LOS
Colorado Boulevard	27 th Street to Heritage Drive	Eastbound	<u>30.1 / E</u>	<u>29.2 / E</u>
		Westbound	<u>20.9 / E</u>	<u>32.2 / E</u>
	Heritage Drive to Maitland Road	Eastbound	<u>25.4 / E</u>	<u>23.7 / E</u>
		Westbound	<u>15.7 / E</u>	<u>29.2 / E</u>
	Maitland Road to Rainbow Road	Eastbound	<u>15.0 / E</u>	<u>12.0 / E</u>
		Westbound	<u>8.1 / D</u>	<u>17.2 / E</u>
	Rainbow Road to US 85 Segment 1	Eastbound	<u>9.9 / D</u>	7.3 / C
		Westbound	4.9 / C	<u>11.1 / D</u>
	Rainbow Road to US 85 Segment 2	Eastbound	<u>9.3 / D</u>	6.9 / C
		Westbound	4.8 / C	<u>11.0 / D</u>
	Rainbow Road to US 85 Segment 3	Eastbound	<u>10.1 / D</u>	7.5 / C
		Westbound	5.3 / C	<u>11.8 / D</u>

Cells noted in Orange Bold Underline correspond to where LOS does not meet acceptable thresholds.

Summary of Traffic Operations Findings

Key corridor-wide findings include:

- Due to limited alternate east/west routes, a sharp increase in east/west volumes are expected with planned development along Colorado Boulevard and to the north of the interstate along Rainbow Road.
 - Pace and density of this development will be an important consideration when identifying the timeline and extent of future Colorado Boulevard improvements.
- Rainbow Road is an important link across I90 in local network connectivity due to continued growth on the north and south side of Colorado Boulevard.

INTERSECTIONS

The following intersection operations were measured at LOS exceeding the LOS C threshold established for this study. In several instances, the increases in east/west volumes associated with planned development will lead to traffic operations that exceed the acceptable threshold in future years.

- **Colorado Boulevard & 27th Street** (Signalized)
 - Existing: LOS D (PM)
 - 2035: LOS D (AM) and LOS E (PM)
 - 2050: LOS F (AM and PM)
- **Colorado Boulevard & Heritage Drive** (TWSC)
 - 2035: LOS F (AM and PM)
 - 2050: LOS F (AM and PM)
- **Colorado Boulevard & Maitland Road** (TWSC)
 - 2050: LOS F (AM and PM)
- **Colorado Boulevard & Rainbow Road** (TWSC)
 - 2035: LOS D (AM) and LOS E (PM)
 - 2050: LOS F (AM and PM)

SIGNAL WARRANT ANALYSIS

A signal warrant analysis was conducted for the unsignalized intersections on Colorado Boulevard. Interpolation of peak hour volumes from existing year 2022 to build year 2050 were used to find an approximate year of signalization of each study intersection. Highway Capacity Software (HCS) Signal Warrant analysis output is provided in the No-Build Traffic Operations Memo provided in **Appendix E**.

Key signal warrant findings include:

- Colorado Boulevard & Heritage Drive
 - Signal warrant met in existing 2022 conditions (Eight and Four Hour Warrants)
- Colorado Boulevard & Maitland Road
 - Signal warrant met in year 2029 (Peak Hour Warrant)¹²
- Colorado Boulevard & Rainbow Road
 - Signal warrant met in year 2030 (Peak Hour Warrant)¹²

TURN LANE WARRANTS

The SDDOT Road Design Manual presents guidelines to evaluating warrants for left and right-turn lanes for the major roadway at unsignalized intersections. A summary of this evaluation is provided in **Table 15**.

Table 15: Future No-Build Conditions Turn Lane Warrant Analysis Summary

Colorado Boulevard Intersection	Posted Speed (mph)	Eastbound						Westbound					
		Left Turn			Right Turn			Left Turn			Right Turn		
		2022	2035	2050	2022	2035	2050	2022	2035	2050	2022	2035	2050
Heritage Drive	45	N/A	N/A	N/A	Met	Met	Met	Met	Met	Met	N/A	N/A	N/A
Maitland Road	55	N/A	N/A	N/A	Met	Met	Met	Not Met	Met	Met	N/A	N/A	N/A
Rainbow Road	55	Not Met	Met	Met	Not Met	Met	Met	Not Met	Met	Met	Not Met	Not Met	Met

¹² The review was based on MUTCD Warrant 3 (Peak Hour) volume thresholds. However, because no study intersections meet an 'unusual case' described in the MUTCD for Warrant 3, the review is only used as a litmus test for when intersection volumes may be nearing Warrant 1 (Eight Hour Vehicular Volume) and Warrant 2 (Four-Hour Vehicular Volume) thresholds for consideration of a signal.

3.16 Crash History Review Summary

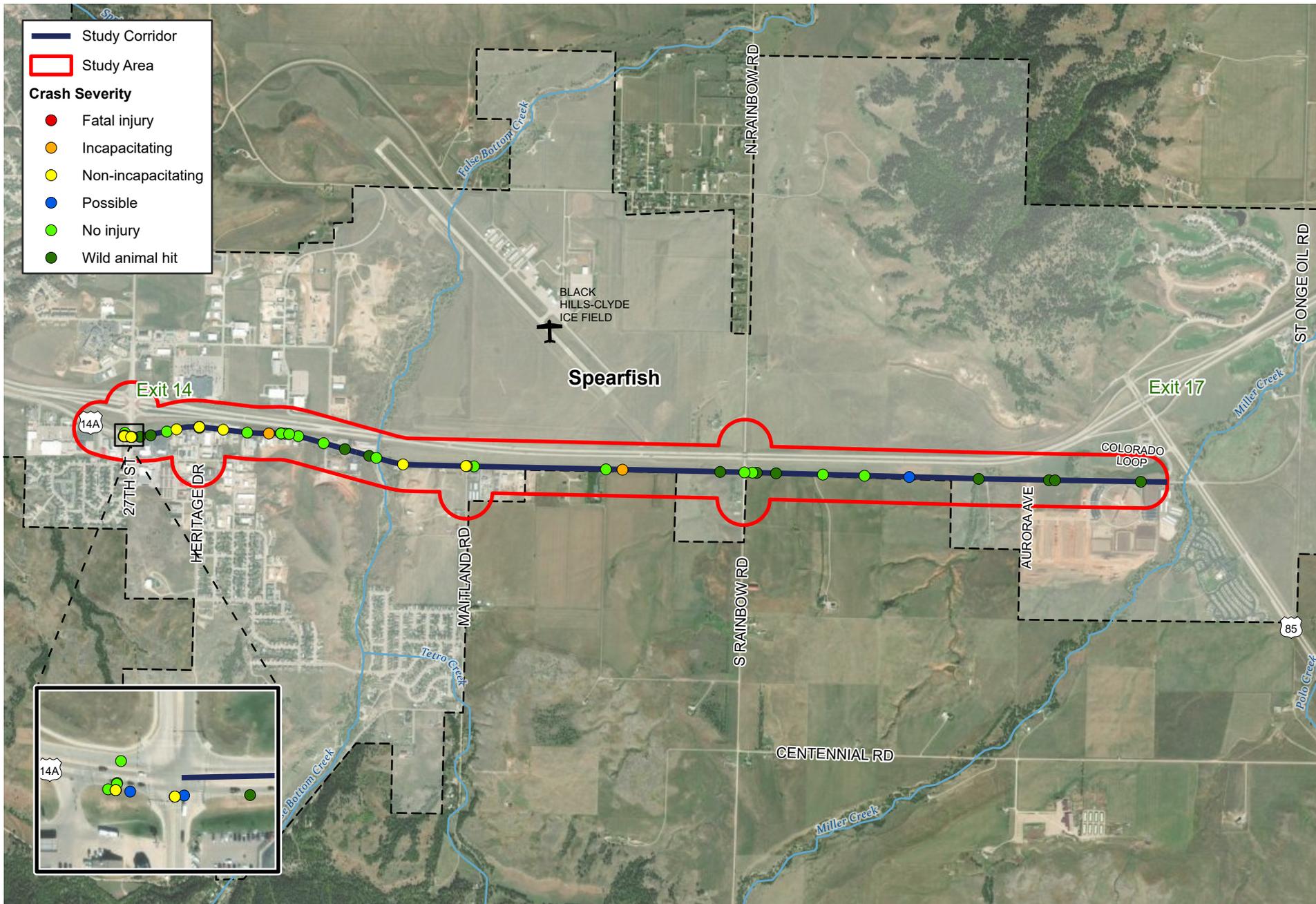
Crash records from the State of South Dakota crash database for years 2017 through 2021 (the five most recent years of complete data) were used for the crash history review. Crash rates and critical crash rates were calculated for both intersections and roadway segments. Intersection crash rates were calculated in terms of crashes per million entering vehicles (crashes/MEV). Roadway segment crash rates were calculated in terms of million vehicle miles traveled (crashes/MVMT).

Figure 16 maps the geographic locations of the crash history while **Figure 17** displays the locations of the severe crash history. Severe crashes are those that result in a fatal or incapacitating injury. **Figure 18** demonstrates the crash density along the corridor. A summary of the crash history review is provided in the following subsections. A more detailed review can be found within the Crash History Review memo provided in **Appendix G**.

Intersection Review

Angle crashes were the most frequent intersection crash type, consisting of approximately 59% of the crashes at these intersections. Rear-end crashes were the second most frequent at 23%. Crashes in winter weather road conditions comprise 16% of the total crashes (including snow, ice, slush or frost). Speeding was an attribute found in 70% of crashes that occurred under winter weather road conditions compared to 11% of crashes that occurred under normal road conditions.

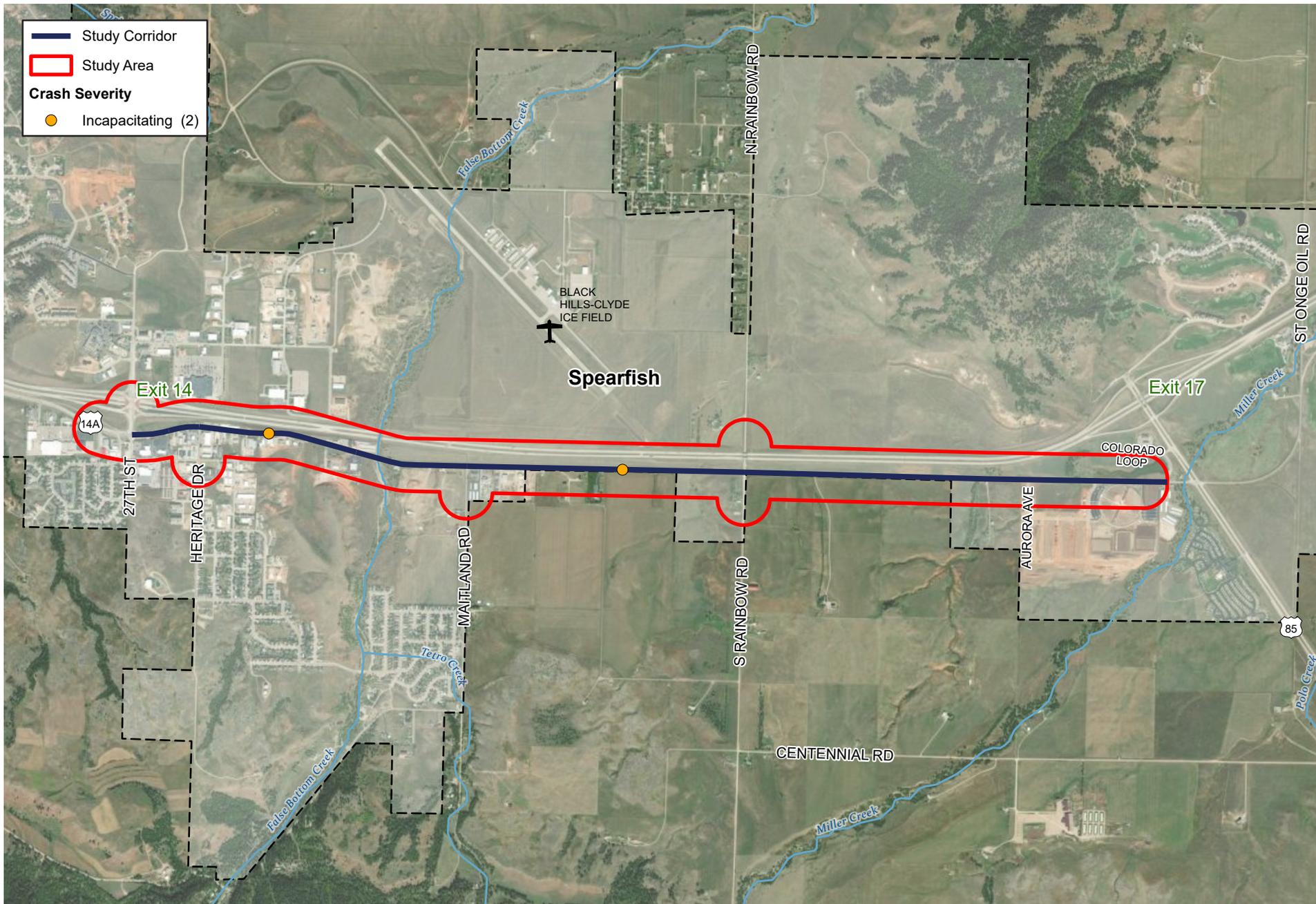
One of the four study intersections exhibit a crash rate greater than or equal to 70% of the critical rate including the intersection of Colorado Boulevard.



CRASH HISTORY (2017 - 2021)

Figure 16

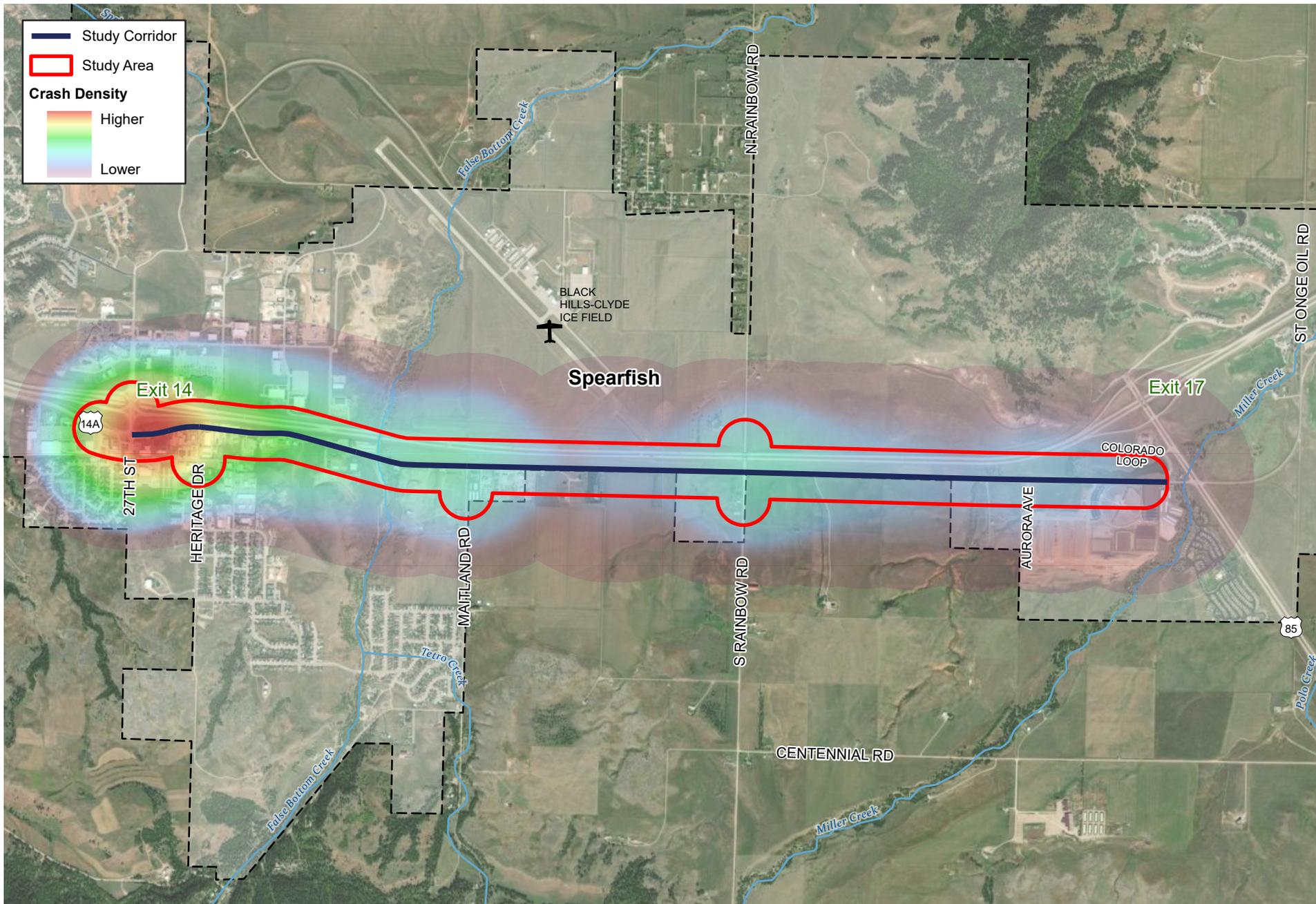




SEVERE CRASH HISTORY (2017 - 2021)

Figure 17





— Study Corridor
 Study Area
Crash Density
 Higher
 Lower

CRASH DENSITY (2017 - 2021)



Figure 18

Intersection Crash History Review — Colorado Boulevard and US14A / 27th Street

- Traffic Control Device: Signal
- Recent Improvements:
 - Reconstruction of I90 Exit 14 as a single point interchange (SPI) and the realignment of the Colorado Boulevard and 27th Street intersection occurred between March 2016 and June 2018. This reconstruction included intersection reconstruction/realignment at this location. Crashes that occurred during that period were removed from this analysis.
- *Crash History* (17 total crashes):
 - Two non-incapacitating injury crashes involving eastbound left and westbound through movement angle collisions
 - 63% of angle crashes involved eastbound left and westbound through movements
 - 35% of crashes involved a failure to yield or disregarding traffic signs
 - 24% of crashes occurred under winter weather road conditions
- Safety Countermeasure Alternatives:
 - Continue periodic signal timing updates as traffic patterns evolve
 - Consider altering the eastbound left turn phase to protected only operation due to:
 - The trend of crashes involving eastbound left and westbound through movements (including 2 non-incapacitating injury crashes)
 - The opposing westbound through 45 mph speed limit
 - Review winter maintenance methods at this intersection

3.17 Segment Crash History Review

Two incapacitating injury crashes were reported on observed corridor segments. The most frequent crash types were single vehicle (68%) and rear-end crashes (19%). 45% of crashes occurred under winter weather road conditions. Speeding was an attribute found in all crashes that occurred under winter weather road conditions compared to 9% of crashes that occurred under normal road conditions. In addition, 45% of crashes occurred at night (32% in unlighted conditions).

One corridor segment along Colorado Boulevard, from Heritage Drive to Maitland Road, exhibited a crash rate greater than or equal to 70% of the critical rate.

Segment Crash History Review — Heritage Drive to Maitland Road

- Crash History:
 - 1 incapacitating injury, driveway access-related crash involving a westbound rear-end collision with a motorcyclist that occurred approximately ¼ mile east of the Heritage Drive intersection
 - 2 non-incapacitating injury crashes involving speeding
 - 50% of single vehicle crashes were wild animal hit crashes
 - 75% of rear-end crashes were driveway access-related
 - 31% of crashes were driveway access-related
 - 31% of crashes occurred at night

- 31% of crashes occurred under winter weather road conditions
- 23% of crashes were wild animal hit crashes
- Safety Countermeasure Alternatives:
 - Review future requests for redevelopment and changes in access for opportunities to further access management techniques
 - Consider locations along this segment where left- or right-turn lanes could reduce rear-end crashes including:
 - Heritage Drive Eastbound Right
 - Heritage Drive Westbound Left
 - Maitland Road Eastbound Right
 - Maitland Road Westbound Left
 - Rainbow Road Eastbound Left Turn
 - Rainbow Road Eastbound Right Turn
 - Rainbow Road Westbound Left Turn
 - Rainbow Road Westbound Right Turn
 - Install additional speed limit and/or speed feedback signage
 - Conduct a speed study to determine if the posted speed limit is appropriate for this segment
 - Increase edge line width to reduce roadway departures
 - Add a four-foot (minimum) shoulder to reduce roadway departures
 - Install traversable surfacing tapers on edge of pavement to reduce roadway departures
 - Install corridor lighting to improve nighttime visibility

Segment Crash History Review — Maitland Road to Rainbow Road

- Crash History:
 - A second incapacitating injury crash, an eastbound rear-end collision, was observed on the corridor segment from Maitland Road to Rainbow Road (located approximately ½ mile east of Maitland Road).
- Safety Countermeasure Alternatives:
 - Install additional speed limit and/or speed feedback signage
 - Increase edge line width to reduce roadway departures
 - Add a four-foot (minimum) shoulder to reduce roadway departures
 - Install traversable surfacing tapers on edge of pavement to reduce roadway departures

4.0 Summary of Transportation Needs

Access Management and Rearage Roads

Almost all of the accesses along the project corridor do not satisfy access density requirements per City of Spearfish criteria for an arterial. There are driveways or minor intersections within the functional areas of the 27th Street, Heritage Drive, and Maitland Road intersections that should be reviewed for access management opportunities. Access management solutions may include closure of redundant accesses, the relocation of an access onto a minor roadway, sharing of accesses between two parcels, and restricting the types of turning movements using a raised median. Frontage or rearage roads may be proposed where feasible to provide an alternate means of providing access to parcels along Colorado Boulevard. A surrounding roadway network figure would be helpful to assist the City and developers plan for roadway connections and allow future access spacing to meet the City's guidelines.

Roadway Geometrics

There are five vertical curves that do not currently meet the minimum criteria for their appropriate design speeds including four sag curves and one crest curve. Review the feasibility of lowering vertical curve number 13 (Crest Curve with PVI Sta 260+92) to determine necessary access reconfiguration and grading limits. It was also noted by members of the public that this area is susceptible to snow drifting.

Major Drainage Structures

The False Bottom Creek bridge will need to be widened or replaced to accommodate additional lanes of travel and potentially for the recreation path if more economical than a separate structure. The Tetro and Miller Creek box culvert structures are recommended for replacement due to their condition ratings and/or age.

Multimodal Facilities

There is a need to investigate the feasibility, safety, and constraints of the recreation path being located on either side of the roadway. The path should consider providing intermittent access to the businesses on the south side of the roadway in the case of the pathway alternative on the north side of the roadway.

Posted Speed

The posted speed limit along Colorado Boulevard is 55 mph but changes to 45 mph west of Maitland Road near False Bottom Creek. Stakeholders and the traveling public have conflicting opinions on whether this should remain a high-speed facility. The results from the corridor speed studies generally support the current posted speed limits. As development along the corridor increases, this may change. The City plans to continue to monitor the 85th percentile speeds and lower the speed limits when the data supports the reduction in speed limits. The study advisory team discussed the desire for the posted speed limit to likely be around 40 to 45 mph once the corridor is fully developed.

Future Traffic Operations

By 2035 and 2050, there are several intersections and highway segments where the LOS does not meet the LOS C threshold established for this study. Several of the study intersections may warrant left or right turn lanes by 2035 and/or 2050. Potential improvements to address the identified traffic operation needs will likely include modification of intersection traffic control, intersection configurations, and/or number of lanes.

Crash History Review

One of the four study intersections exhibit a crash rate greater than or equal to 70% of the critical rate including the intersection of Colorado Boulevard and 27th Street and the intersection of Colorado Boulevard and US85.

- **Colorado Boulevard and 27th Street:** According to the Spearfish Area MTP, this intersection was listed as having the highest number of total accidents between 2006 to 2009. This intersection was then realigned as part of the I90 Exit 14 reconstruction project completed in June 2018. This allowed for the adequate spacing between the single point interchange ramp terminal intersection and the Colorado Boulevard intersection. It also cleaned up the offset between two T-intersections and brought them together as one intersection. Crashes that occurred during that period were removed from this analysis. Several of the crashes at this intersection after reconstruction involved angle crashes (47% of crashes) and winter weather road conditions (24% of crashes). Of the angle crashes, 63% involved the eastbound left and westbound through movements. It is recommended that the signal timing be updated as traffic patterns evolve, consideration be given to altering the eastbound left turn phase to protected only operation, and winter maintenance methods are reviewed at this intersection. Snow removal is completed by SDDOT on the west and north legs of the intersection while snow removal is completed by the City on the east and south legs of this intersection.

The segment of Colorado Boulevard from Heritage Drive to Maitland Road exhibited a crash rate greater than or equal to 70% of the critical rate. This segment and other segments of Colorado Boulevard may benefit from access management techniques, the addition of warranted left- or right-turn lanes as listed previously, additional speed limit and/or speed feedback signage, the addition of a shoulder, and corridor lighting.

5.0 Concept Development

Study process Step 2 began with a two-part SAT workshop on March 16, 2023 and March 31, 2023, to brainstorm potential concepts to address identified transportation issues and needs. The first part of the SAT workshop focused on the typical section, roadway segments, and the study intersections. The second part of the SAT workshop focused on multimodal facilities. The purpose of this workshop was to review the feedback received from stakeholders and the public, establish the transportation needs to be addressed by the Study, and brainstorm concepts for development and evaluation.

5.1 Corridor Scenarios

Five preliminary corridor scenarios in addition to the no-build scenario were preliminarily analyzed prior to the SAT workshop to guide the SAT workshop. The results from this preliminary analysis are shown in **Table 16**.

- Scenario A: 5-lane section (west of Rainbow Road) & 3-lane section (east of Rainbow Road)
- Scenario B: 5-lane section (west of Rainbow Road) & 3-lane section (east of Rainbow Road) with turn lanes
- Scenario C: 5-lane section (west of Rainbow Road) & 3-lane section (east of Rainbow Road) with turn lanes and signalization
- Scenario D: 5-lane section (west of Rainbow Road) & 3-lane section (east of Rainbow Road) with turn lanes; Single-lane roundabout at Rainbow Road; Multilane roundabouts at 27th Street, Heritage Drive, and Maitland Road
- Scenario E: 5-lane section (west of Rainbow Road) & 3-lane section (east of Rainbow Road) with turn lanes; Multilane roundabouts at all study intersections

Table 16. Preliminary Traffic Operations Analysis of Corridor Scenarios

Location	No-Build		Scenario A		Scenario B		Scenario C		Scenario D		Scenario E	
	2035	2050	2035	2050	2035	2050	2035	2050	2035	2050	2035	2050
Roadway Segments												
27th Street to Heritage Drive	<u>E</u>	<u>E</u>	A	B	A	B	A	B	A	B	A	B
Heritage Drive to Maitland Road	<u>D</u>	<u>E</u>	A	B	A	B	A	B	A	B	A	B
Maitland Road to Rainbow Road	C	<u>E</u>	A	B	A	B	A	B	A	B	A	B
Rainbow Road to Aurora Avenue	B	C	B	C	B	C	B	C	B	C	B	C
Aurora Avenue to US85	B	C	B	C	B	C	B	C	B	C	B	C
Intersections												
27th Street Intersection	<u>E</u>	<u>F</u>	C	<u>E</u>	C	C	C	C	B	<u>F</u>	B	<u>F</u>
Heritage Drive Intersection	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	A	B	A	B	A	B
Maitland Road Intersection	<u>F</u>	<u>F</u>	<u>D</u>	<u>F</u>	C	<u>F</u>	A	A	A	A	A	A
Rainbow Road Intersection	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	A	C	A	<u>D</u>	A	B

Cells noted in **Orange Bold Underline** correspond to where LOS does not meet acceptable thresholds.

5.2 Roadway Segment Concepts

Typical Sections

The typical sections considered for further investigation were based on future traffic operations, crash history review, public/stakeholder feedback, and the other transportation needs identified during the existing and future conditions analysis. The roadway typical section was concluded to be the following:

- Five-lane section with a two-way left turn lane (from 27th Street to Rainbow Road)
- Three-lane section with a two-way left turn lane (Rainbow Road to Colorado Loop)
- Curb and gutter and storm sewer (at minimum on the south side)
- No raised median (except where needed at intersections)
- Roadway lighting for length of roadway segment
- Multimodal improvements including sidewalk and a recreation path

The number of through lanes will be further investigated during the build alternative traffic operations analysis in the proceeding sections of the report. A center left turn lane is needed to improve safety and roadway capacity. An urban section with curb and gutter and storm sewer was desired to reduce the footprint of the roadway and introduce traffic calming.

Roadway Lighting

Roadway lighting was determined to be necessary to improve roadway and recreation path safety. The lighting photometric design will take place during final design, but the SAT wanted to note that it should take into account effects to interstate traffic, height limitations due to FAA regulations within the Black Hills Clyde Ice Field runway protection zone, and dark-sky design principals.

Access Management

Access management methodologies that can improve the safety and efficiency of the transportation network include:

- Driveway consolidation
- Driveway relocation to a more minor street
- The addition of raised medians
- The adequate spacing of future driveways

Driveway consolidation was determined to be the primary method of access management along the Colorado Boulevard corridor. Since there were minimal accesses on the north side of the roadway, the raised median will not provide as much benefit as driveway consolidation could along the corridor. Stakeholders also expressed concerns with the inclusion of raised medians due to the lack of snow storage and the restriction of access. The SAT was open to including raised median as needed within the functional area of intersections.

5.3 Intersection Concepts

Intersection configuration, control type, frontage roads, and access management surrounding the intersection were part of the concept development process. The corridor scenarios listed previously focused on the addition of through lanes, the addition of turn lanes, and different intersection control types.

As shown in **Table 16**, both scenario A and B are not enough to improve the level of service to acceptable levels at the Heritage Drive, Maitland Road, and Rainbow Road intersections. Scenario C introduces signals at all study intersections and is expected to provide acceptable levels of service at all study intersections. Scenario D introduces multilane roundabouts at all study intersections with the exception of a single-lane roundabout at Rainbow Road. This configuration is expected to provide acceptable levels of service at Heritage Drive and Maitland Road. Scenario E is the same as Scenario D except Rainbow Road is upgraded from a single lane roundabout to a multilane roundabout. With this multilane roundabout configuration, Rainbow Road is expected to operate at acceptable levels of service in the future condition. A roundabout is not expected to provide acceptable levels of service at the 27th Street intersection.

27th Street Intersection

Under its current configuration, the 27th Street intersection is expected to operate at levels of service E and F in the 2035 and 2050 no-build peak hour future conditions, respectively. The crash history at this intersection exhibits a crash rate greater than or equal to 70% of the critical rate. There were two non-incapacitating injury crashes involving eastbound left and westbound through movement angle collisions, and 63% of angle crashes involved eastbound left and westbound through movements. Two accesses on this intersection's east leg are within the functional area of the intersection.

The 27th Street intersection was previously reconstructed as part of the Exit 14 reconstruction project and substantially complete by 2018. Based on the preliminary traffic operations analysis, a multilane roundabout does not provide acceptable levels of service in the future conditions. However, the 27th Street intersection is expected to operate at acceptable levels of service with Scenario B assuming the addition of two east-west lanes in each direction and dual eastbound left turn lanes. This could be accomplished by widening from what was previously constructed at this intersection and be the most cost-effective solution moving forward. No other alternative intersection types were deemed as feasible or cost effective at this intersection.

It was concluded that maintaining/optimizing the signal and adding the necessary capacity improvements was the only build alternative at this study intersection moving forward to the next step in the concept development process.

Heritage Drive Intersection

The Heritage Drive intersection is expected to operate at level of service F in both 2035 and 2050 no-build peak hour future conditions and meets traffic signal warrants using existing volumes (Eight and Four Hour Warrants). There are two accesses within the intersection functional area. The public noted that queueing is being observed at the intersection during peak hours and

turning left out of this intersection is getting more difficult to find gaps. The intersection isn't currently designed to accommodate truck traffic, and trucks are currently having to wait for traffic to clear on Heritage Drive in order to complete their turns.

Four intersection control types were brainstormed at the Heritage Drive intersection including a traditional signal with turn lanes, a multilane roundabout, a three-quarter access intersection with 4th Avenue as the alternate route, and a continuous green T. While a two-lane roundabout would likely work from a traffic operations perspective, it was ruled out as a feasible alternative due to the large footprint and impacts to nearby buildings. A three-quarter access was also deemed as an unfeasible alternative, because it would cause significant rerouting of traffic through the local street network and perceived impacts to the local businesses. A continuous green-T was not favorable due to the impacts to business access, but the City wanted to see how this concept looked once laid out.

It was concluded that the following Heritage Drive intersection alternatives would proceed to the next step in the concept development process. Access management to be reviewed with all of the listed alternatives.

1. A traditional signal with turn lanes and a raised median through the functional area
2. A continuous green T intersection with a right-in right-out northern approach to the storage units

Maitland Road Intersection

Under its current configuration, the Maitland Road intersection is expected to operate at levels of service A and F in the 2035 and 2050 no-build peak hour future conditions, respectively. The public noted that turn lanes were needed at this intersection, and it is becoming more difficult to turn left out of this intersection. An access on the north side of this intersection is proposed as part of a development which will turn this intersection from a T-intersection into a four-way intersection. There are concerns with winter conditions at this intersection with ice frequently causing sliding of turning traffic through the intersection. Similar to Heritage Drive, the Maitland Road intersection isn't currently designed to accommodate truck traffic, and trucks currently have to wait for traffic to clear on Maitland Road in order to complete their turns. There are currently three accesses within the functional area of the intersection.

Three intersection control types were brainstormed at the Maitland Road intersection including a traditional signal with turn lanes, a multilane roundabout, and a continuous green T. There are concerns with a traditional signal being located at this intersection with the potential safety drawbacks of an isolated signal that doesn't meet driver expectancy. There is enough room for a roundabout to fit; however, it would need to stay out of the interstate right-of-way and limit impacts to the surrounding businesses as much as feasible. Since the parcel to the north requires full access, the continuous green T concept at this intersection was eliminated. It was also discussed whether a frontage road was needed for the southwest quadrant access points, but the City has since removed or plans to remove the two accesses immediately to the west of Maitland Road.

It was concluded that the following Maitland Road intersection alternatives would proceed to the next step in the concept development process. Access management to be reviewed with all of the listed alternatives.

1. Traditional signal with turn lanes and no raised median
2. Multilane roundabout

Rainbow Road Intersection

Under its current configuration, the Rainbow Road intersection is expected to operate at levels of service F in both the 2035 and 2050 no-build peak hour future conditions. There are currently no existing accesses within the functional area of the intersection. Improvements on the north leg of the intersection will be limited by the I90 bridges approximately 220 feet to the north of the intersection.

Two intersection control types were brainstormed at the Rainbow Road intersection including a traditional signal with turn lanes and a multilane roundabout. There are concerns with a traditional signal being located at this intersection with the potential safety drawbacks of an isolated signal that doesn't meet driver expectancy. There is enough room for a roundabout to fit; however, it would need to stay out of the interstate right-of-way and be shifted to the south.

It was concluded that the following Rainbow Road intersection alternatives would proceed to the next step in the concept development process.

1. Traditional signal with turn lanes and no raised median
2. Multilane roundabout

Summary of Intersection Feasible Build Alternatives

The concept development process resulted in the following feasible build alternatives carried forward for further evaluation and refinement as listed in **Table 17**.

Table 17. Summary of Intersection Build Alternatives

Intersection	Build Alternative
Colorado Boulevard & 27 th Street	T1 - Traditional Signal
Colorado Boulevard & Heritage Drive	H1 - Traditional Signal
	H2 - Continuous Green T
Colorado Boulevard & Maitland Road	M1 - Traditional Signal
	M2 - Roundabout
Colorado Boulevard & Rainbow Road	R1 - Traditional Signal
	R2 - Roundabout

5.4 Multimodal Facility Concepts

There was significant feedback from the public regarding a recreation path extension needed from 27th Street to US85. The side of the road the recreation path would be located, locations of sidewalk needs, bike lane configuration, future connections to other auxiliary paths, and grade-separated crossings were all part of the concept development process for multimodal facilities.

Recreation Path Concepts

The proposed recreation path alternatives were broken down into smaller corridor segments to allow for context sensitive solutions to be considered. The termini of the recreation path segments were selected based on opportunities for a grade-separated pedestrian crossing or an enhanced/signalized at-grade crossing opportunity at a major intersection:

- Path Segment 1 - 27th Street to False Bottom Creek
- Path Segment 2 - False Bottom Creek to Rainbow Road
- Path Segment 3 - Rainbow Road to Miller Creek

For each of these segments, the SAT wanted to explore the benefits and drawbacks of placing the recreation side path on the north side and south side of Colorado Boulevard. They also wanted to review an option that would take the recreation path away from the side of Colorado Boulevard to be placed adjacent to a less busy local or collector street.

Connectivity to future north-south pathways were also noted for consideration including a path along False Bottom Creek that is planned north of the interstate and south of Colorado Boulevard to the Mountain Shadows Estates residential development and City of Spearfish dog park. There is also a planned shared use path on the east side of Rainbow Road from the north side of Colorado Boulevard to the Centennial Mountain Estates development. There is also a desire for connectivity between the Colorado Boulevard recreation side path, the Sky Ridge development, and Elk Horn Ridge development to the north of Colorado Boulevard and to the west of US85.

Grade separated pedestrian crossings, specifically pedestrian underpasses, are desired at auxiliary path connections. The SAT sees opportunities to provide these grade-separated connections at False Bottom Creek, Tetro Creek, and Miller Creek. The Miller Creek underpass will be explored further in the US85 Corridor Study. However, the pedestrian underpasses at False Bottom and Tetro Creek need to be investigated further in the next phase of the concept development process.

The public noted that pedestrian/bicyclist enhancements were needed at the crosswalks of the 27th Street intersection. There have been several close calls between the southbound right turning movement and the pedestrians occupying the west leg's north-south crosswalk. This concern was confirmed by the intersection safety review completed by Street Simplified LLC that found 11 to

14 near miss events over two days in July and August 2022, as summarized in **Figure 19**.¹³ Pedestrian volumes are expected to increase with the extension of the recreation path to the east.

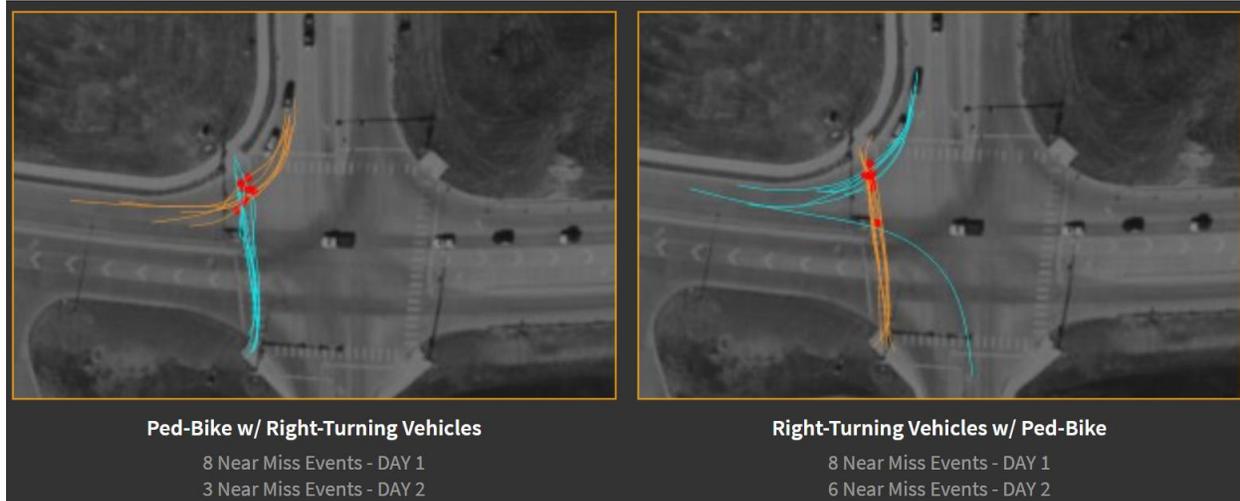


Figure 19. Vulnerable Road User Conflicts at the 27th Street and Colorado Boulevard Intersection

Several solutions were suggested including a grade separated crossing near the 27th Street intersection, reducing the curb radii to reduce pedestrian crossing lengths, the addition of raised truck aprons to reduce vehicular turning speeds, and including a leading pedestrian interval (LPI) to increase pedestrian visibility by providing a ‘head start’ for pedestrians/bikes in the crosswalk. Due to the high construction cost of most of these options and the recent reconstruction of the 27th Street intersection, the SAT wanted to further investigate the impacts of the LPI timing to the intersection traffic operations. The SAT wanted the other options to still be on the table if additional funding were to be available in the future.

In-Street Bike Facility Options

Spearfish Bicycle Collective and members of the public commented on the need for not solely a recreation path extension but also the need for in-street bike facility options. Commuter and serious bicyclists in Spearfish prefer to be within an in-street bike facility due to their speed differential between casual recreation path users compared to commuter bicyclists. They also noted buffered bike lanes would be preferred due to the speeds being greater than 45 mph. In addition, the bicyclist community stated there needs to be greater visibility and safety at the intersections including bike lanes to the left of right turn lanes, a two-stage left turn at intersections rather than merging into the motorized vehicle lane to make left turn, and flashing beacons at any unsignalized crossings.

¹³ Street Simplified. (Day 1: July 6, 2022 3:45 PM to July 7, 2022 4:00 PM & Day 2: August 16, 2022 4:00 PM to August 17, 2022 9:00 AM). *N 27th Street & Colorado Blvd Street Safety Review*. Retrieved from https://www.beautiful.ai/player/-NjNBmngtkNp_twwz02f/Insight-Report-South-Dakota-DOT-N-27th-St-and-Colorado-Blvd-Day1and2

Other arterials in Spearfish, such as Jackson Boulevard, have four-foot to five-foot bike lanes. If bike lanes were to be included on Colorado Boulevard, the City would like to match that width. Ultimately, it was decided to investigate different combinations of bike lane options with varying levels of separation/protection and directional differences. All options would include sidewalk as needed adjacent to the developments and to provide connectivity to those developments where the recreation side path was absent.

Transit

Prairie Hills Transit (PHT) provided input during the concept development process. They are considering a fixed route loop along Colorado Boulevard in the next three to five years. The City plans to work with PHT in the future on where these stops could be located. The preference would be for these stops to be located off of the crossroads instead of Colorado Boulevard.

6.0 Build Alternatives

6.1 Grouping Methodology

The build alternatives were divided and grouped into the roadway segments and intersection alternatives as represented in **Figure 20**. The segment alternatives were further broken down into the typical section, path and sidewalk options, and bike lane options. The intersection alternatives involved mainly capacity and safety improvements such as the addition of lanes, control type, and different forms of access management. Although all of the alternatives are interrelated to some extent, it was important to focus the analysis on each component separately to weigh the merits of each potential improvement.

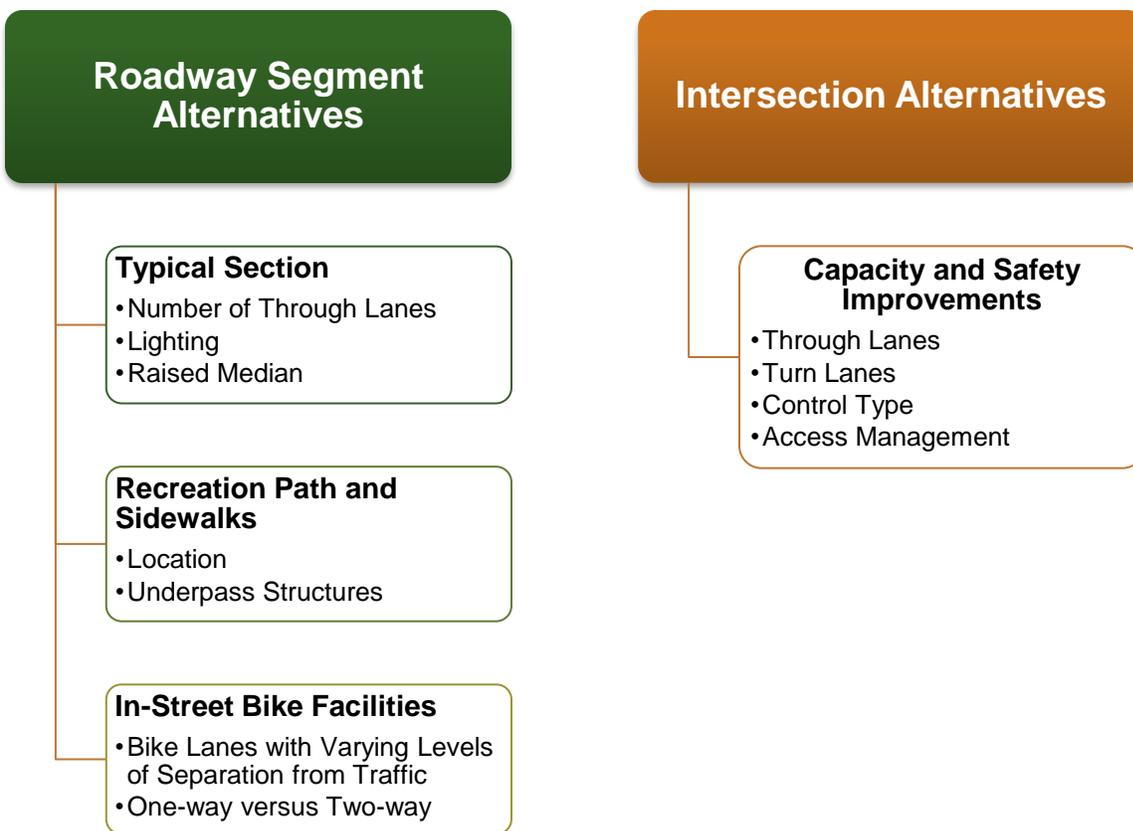


Figure 20. Build Alternative Grouping Methodology

6.2 Roadway Segment Alternatives

Typical Sections

The proposed 3-lane and 5-lane sections are displayed in **Figure 21** and **Figure 22**. The 5-lane typical section is applicable to the roadway segment from 27th Street to Rainbow Road. The 3-lane typical section is applicable to Rainbow Road to Colorado Loop. The plan view of the roadway segments can be seen in **Figure 23** through **Figure 28**.

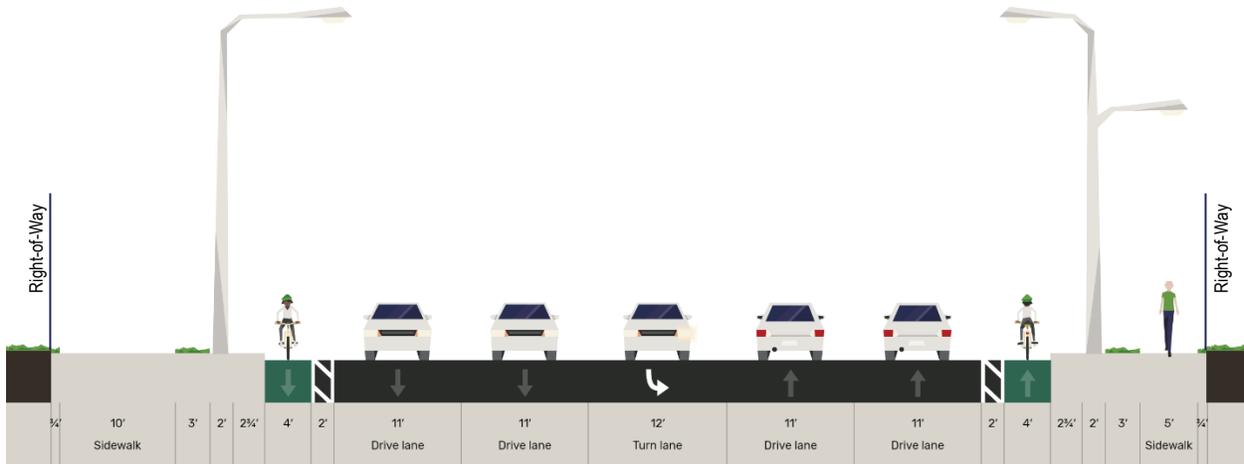


Figure 21. 5-Lane Typical Section

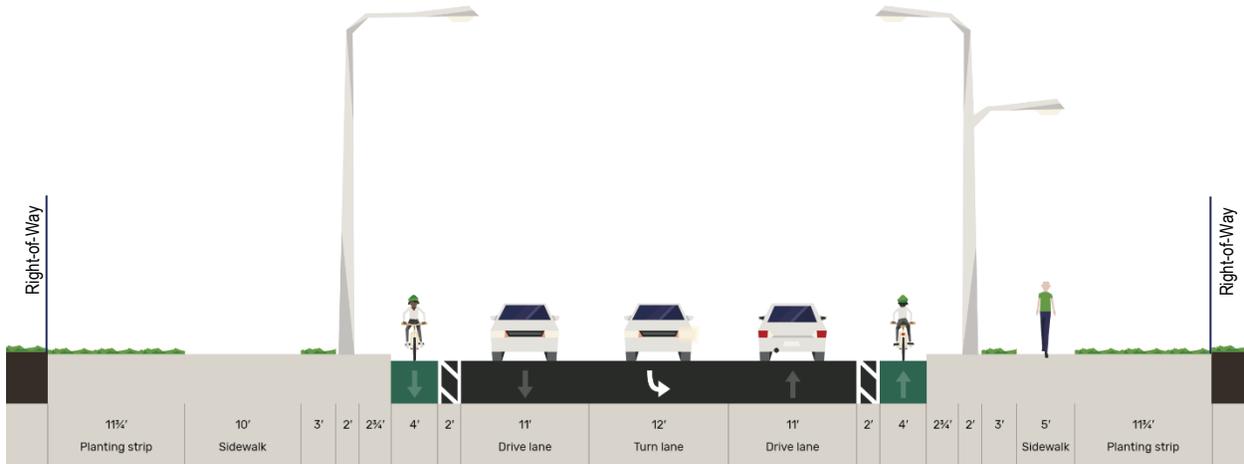


Figure 22. 3-Lane Typical Section

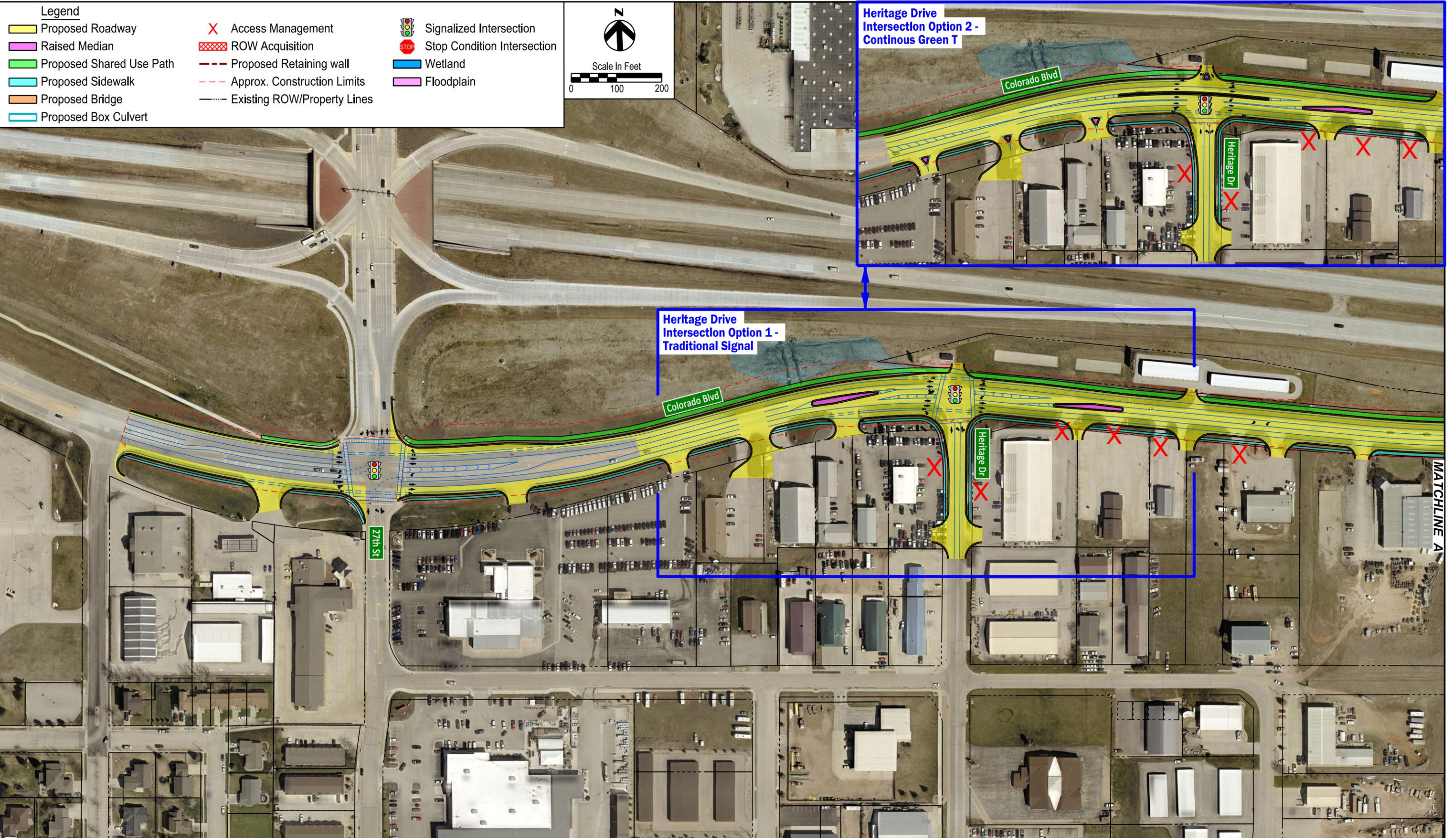


FIGURE 23

Revision:



Roadway Options - 27th Street to East of Heritage Drive

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Concept #
T1, H1,
H2, Road
Segment 1

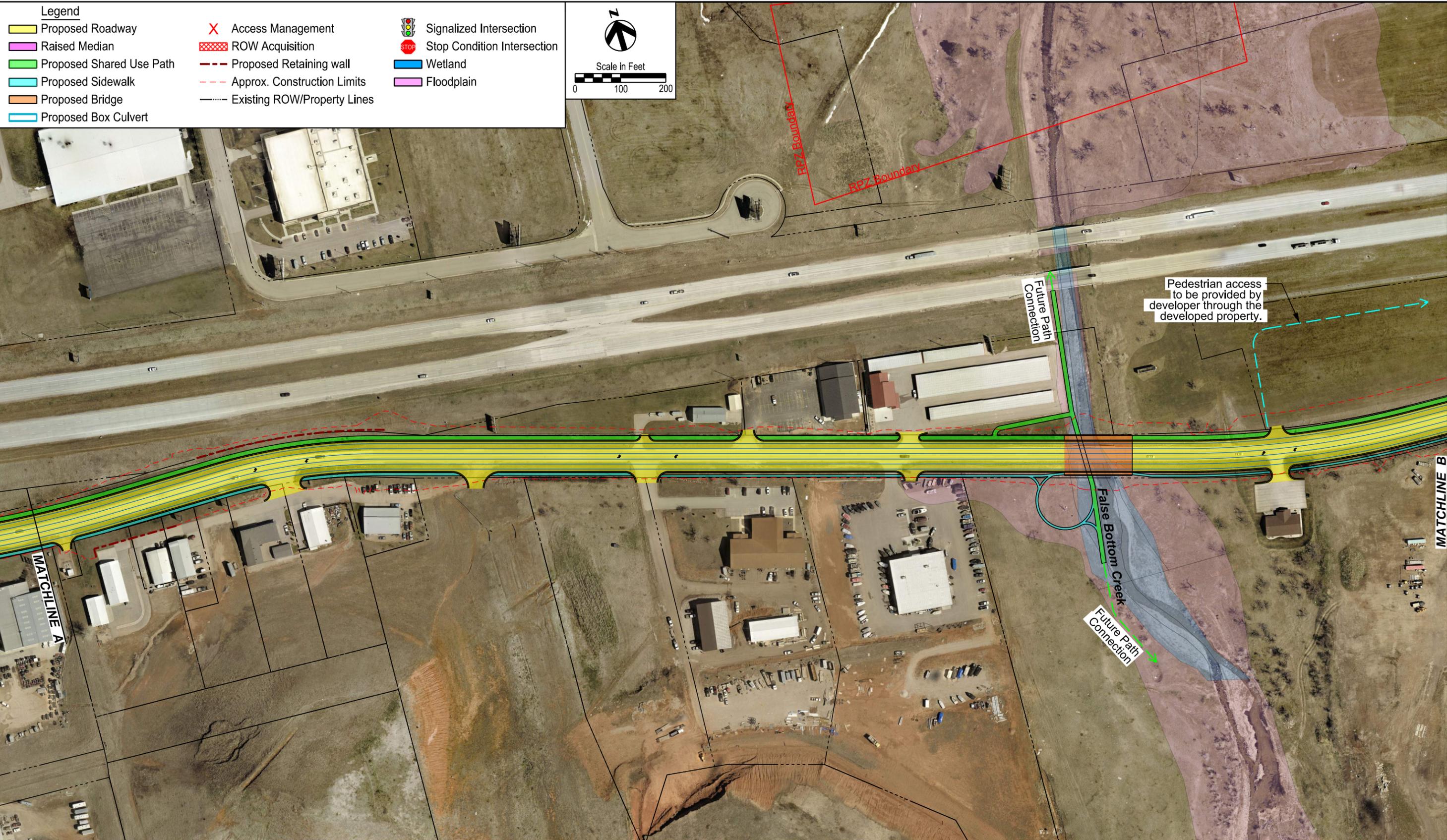


FIGURE 24

Revision:



Roadway Options - East of Heritage Drive to False Bottom Creek

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Concept #
Road
Segment 1

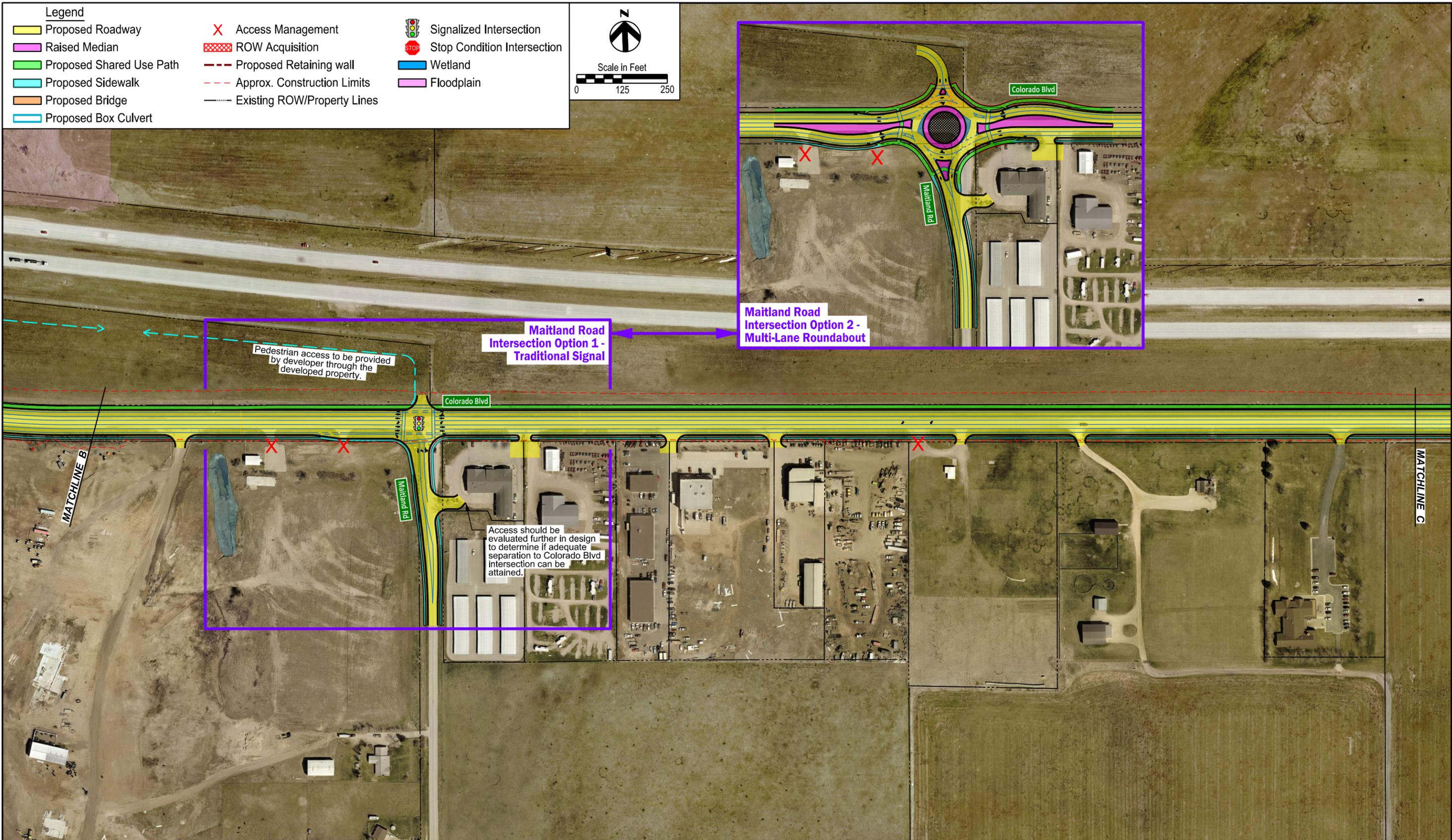


FIGURE 25

Revision:



Roadway Options - False Bottom Creek to West of Rainbow Road

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Concept #
M1, M2,
Road
Segment 2

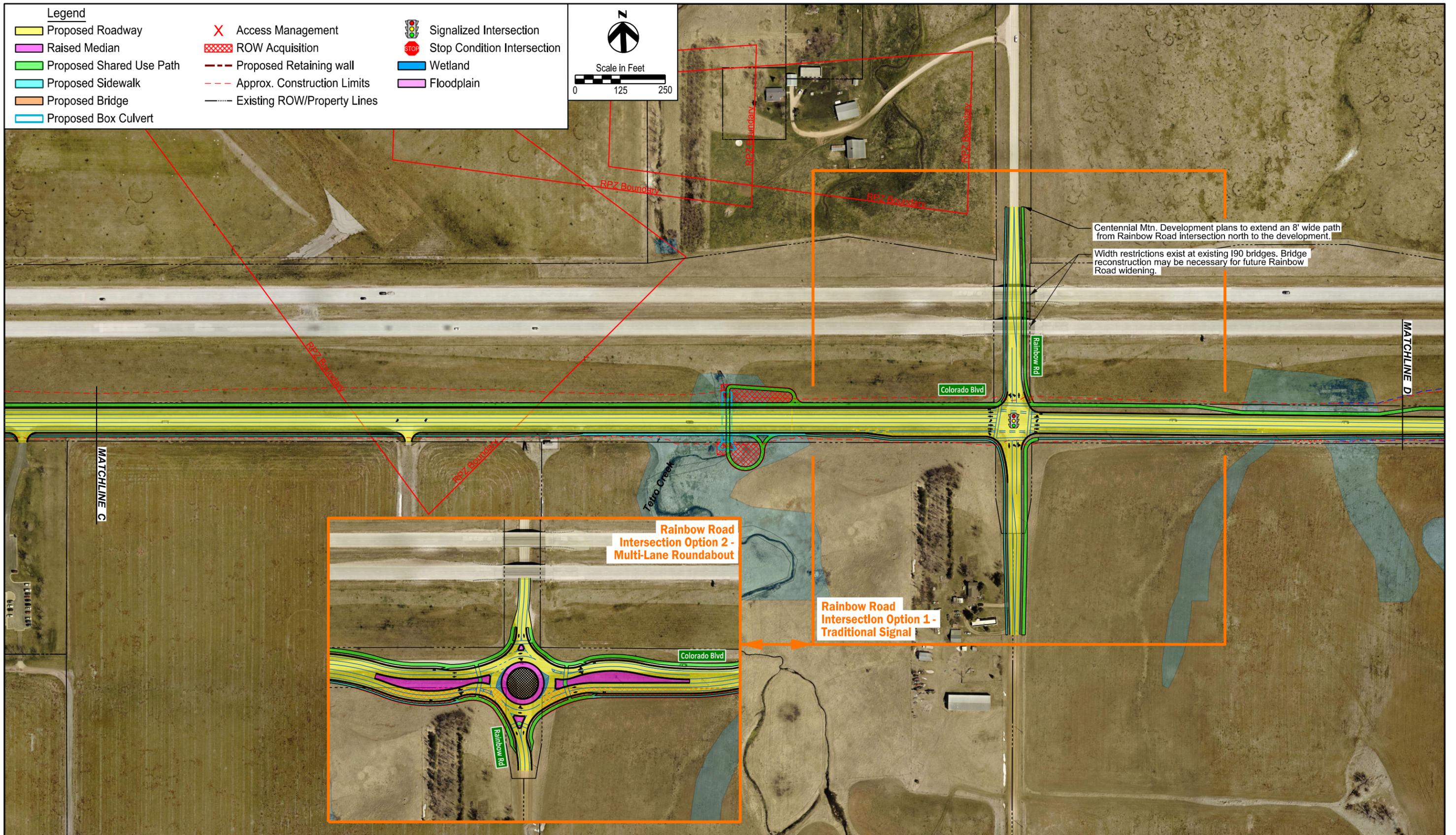


FIGURE 26

Revision:



Roadway Options - Rainbow Road Area

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Concept #
R1, R2,
Road
Segment 2

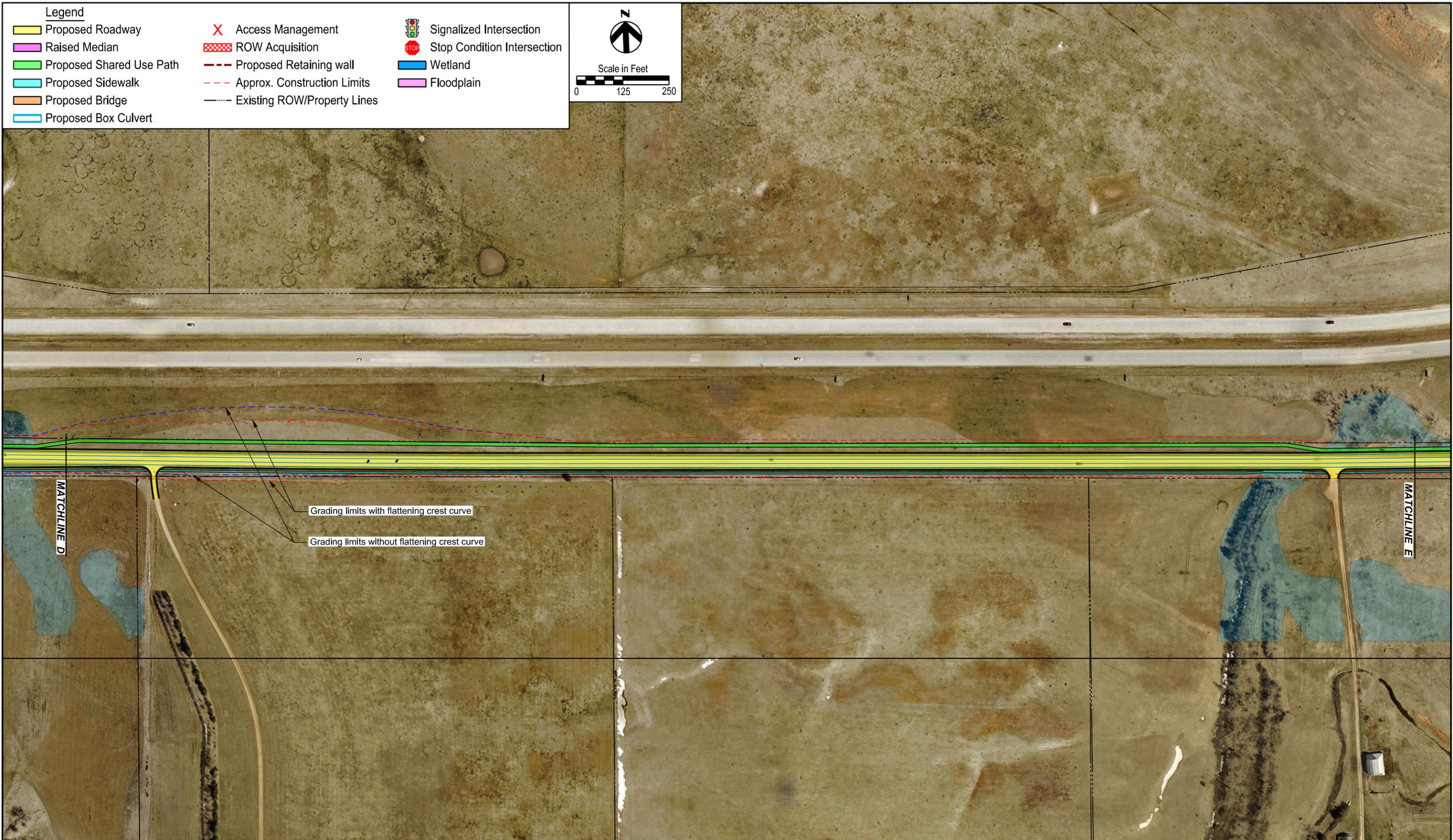


FIGURE 27

Revision:



Roadway Options - East of Rainbow Road to West of Aurora Avenue

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Concept #
Road
Segment 3

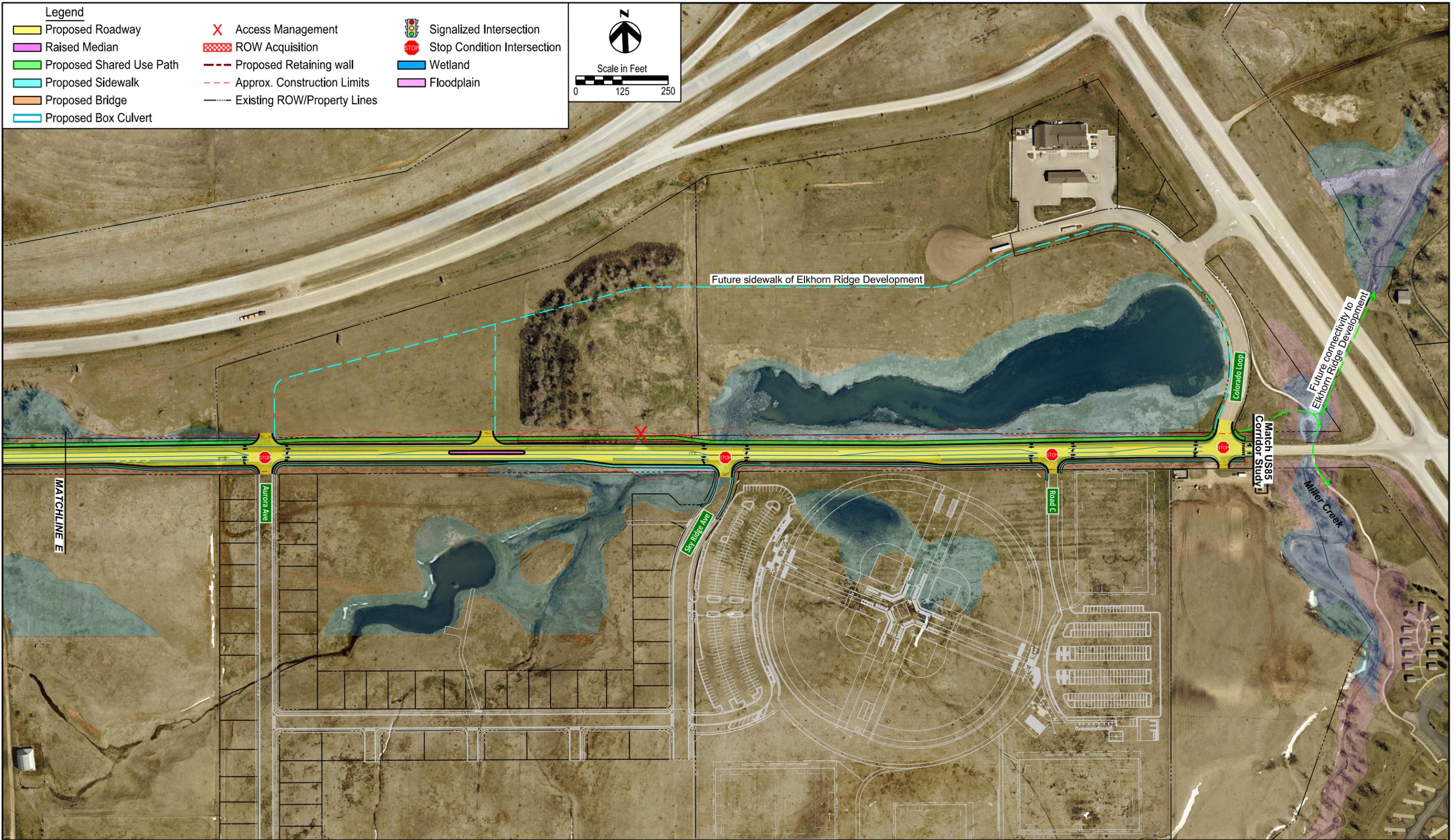


FIGURE 28

Revision:



Roadway Options - Aurora Avenue to Colorado Loop

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Concept #
Road
Segment 4

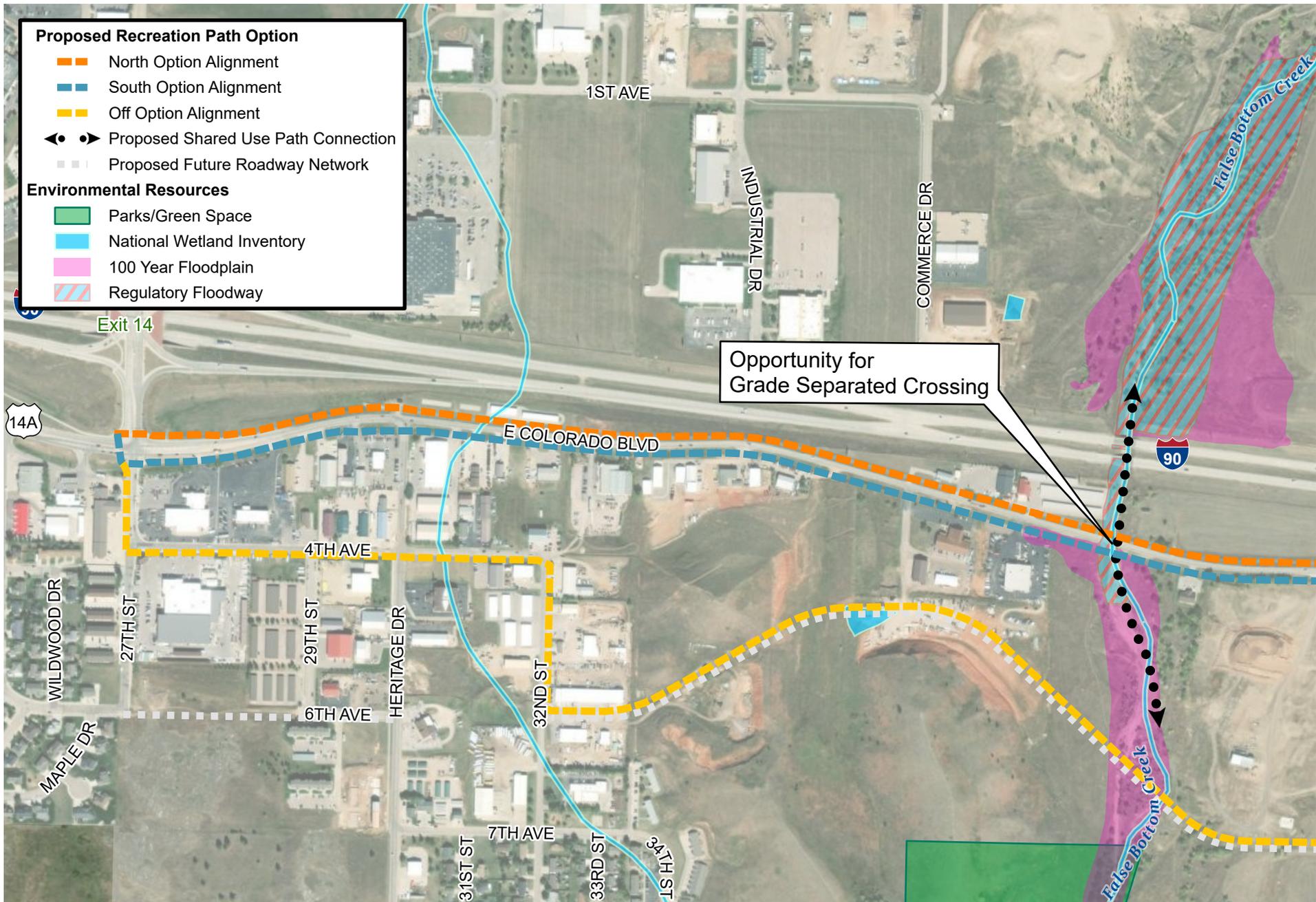
Spearfish, SD

Recreation Path and Sidewalks

Three recreation path alternatives, as shown in **Figure 29** through **Figure 31**, were considered:

- North side of Colorado Boulevard
- South side of Colorado Boulevard
- Off-Alignment of Colorado Boulevard (adjacent to a parallel local or collector roadway or development)

The north and south side recreation alternatives and other necessary sidewalks would generally begin approximately five feet behind the curb and gutter. This boulevard area could either be vegetated or paved. Recreation path and sidewalk could be attached to the curb and gutter where either the fill or the path itself causes impacts to adjacent landowners. The off-alignment alternative would be located to the south of Colorado Boulevard along a future collector roadway for the majority of its length. However, there is an option to locate the path along Colorado Loop on the very east end of the corridor. For this reason, Segment 3b has the off-alignment alternative broken down into a north and south option.



RECREATION PATH - SEGMENT 1

Figure 29



0 600 Feet





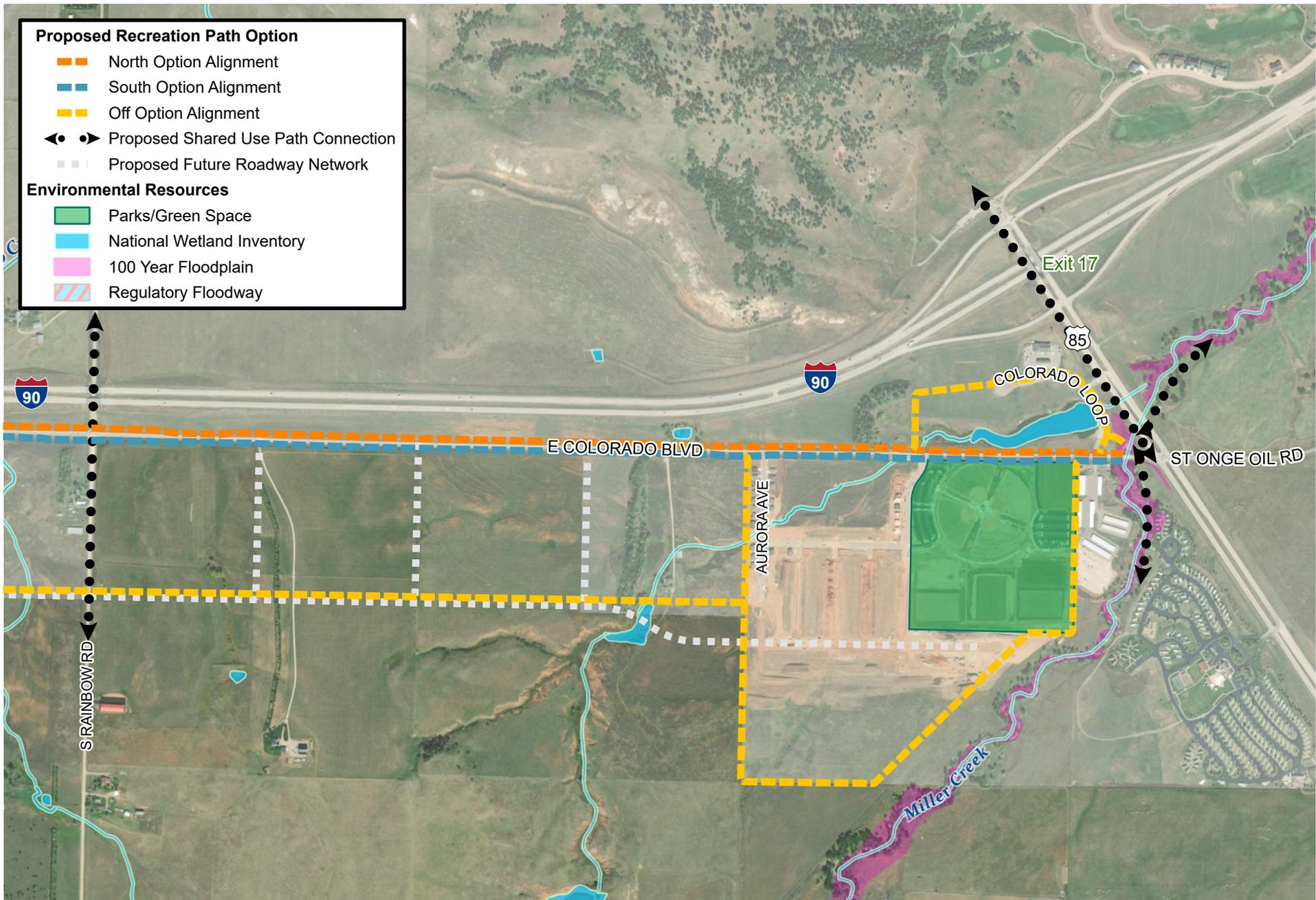
RECREATION PATH - SEGMENT 2

Figure 30



0 800 Feet





RECREATION PATH - SEGMENT 3

Figure 31



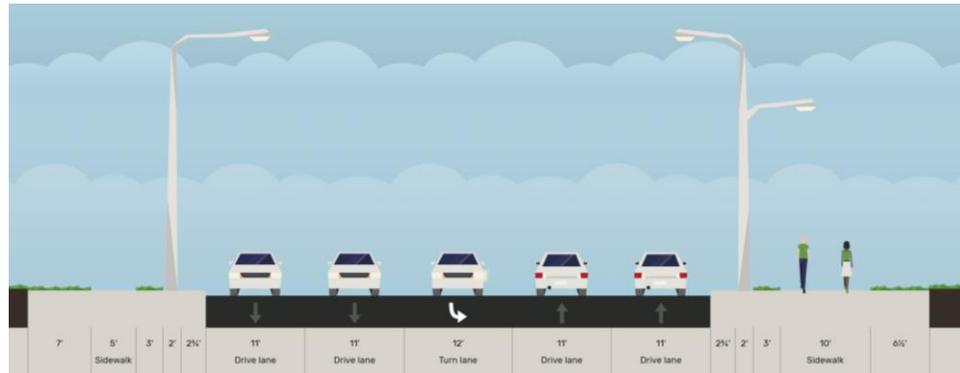


0 1,000 Feet 

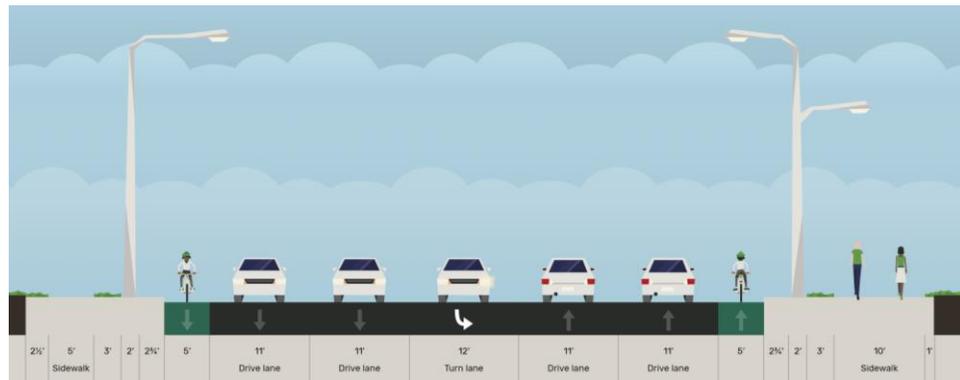
In Street Bike Facilities

The in-street bike facility options are listed below. These facilities vary in terms of uni-directional and bi-directional, separation between the bike lane and the adjacent lane of travel with the use of a painted buffer, protection with the use of raised median, and the presence or absence of bike lanes and recreation path.

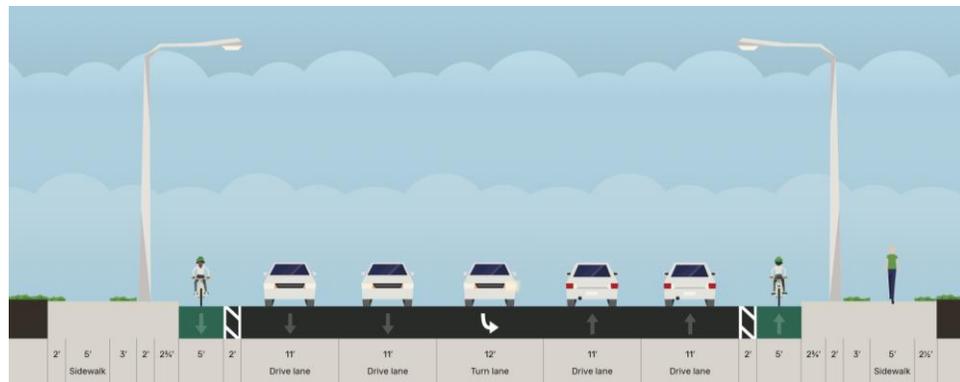
Option 1
No bike lanes with the recreation side path



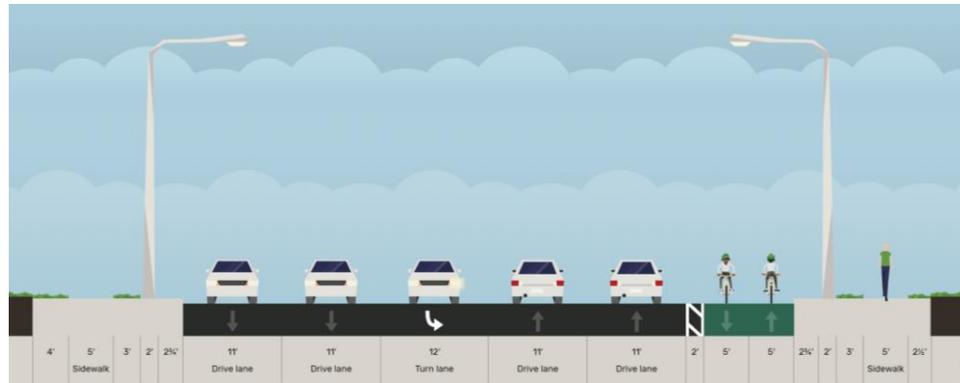
Option 2
Conventional bike lanes with the recreation side path



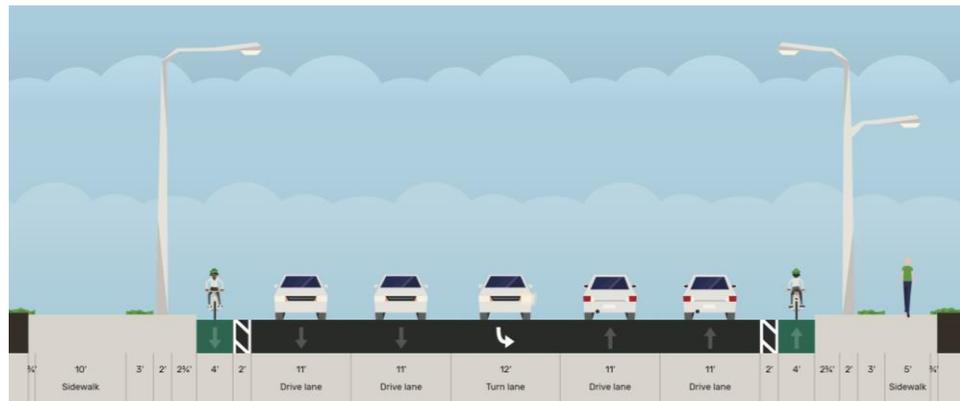
Option 3a
One-way buffered bike lanes on either side of road with no recreation path



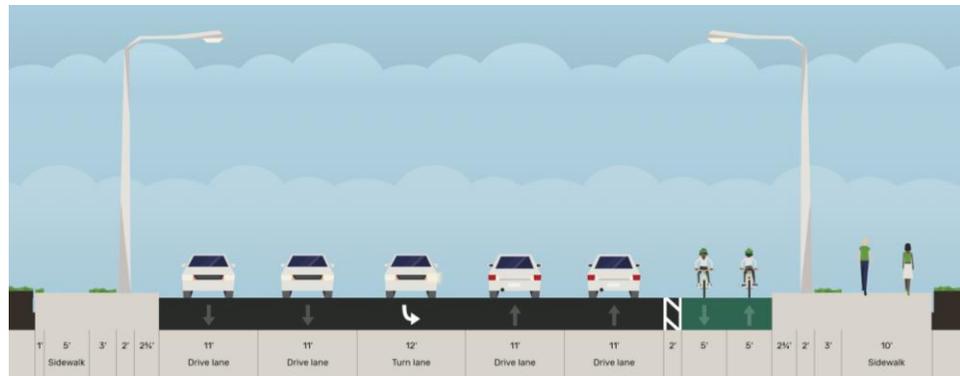
Option 3b
Two-way buffered bike lane on one side of the road with no recreation path



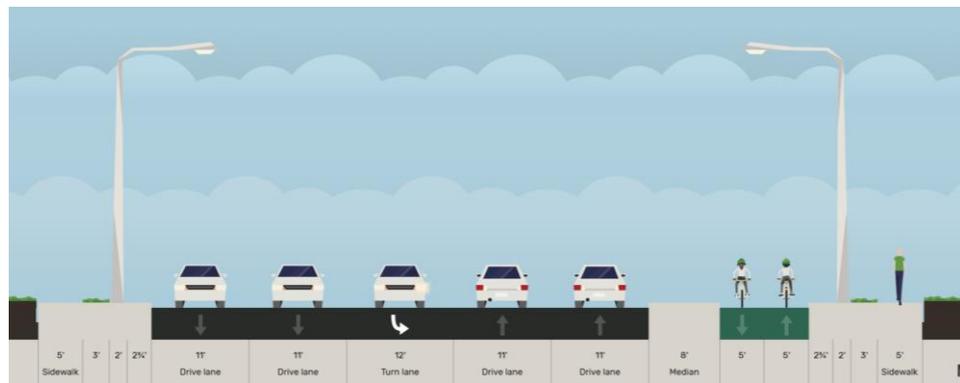
Option 3c
One-way buffered bike lane on both sides of road with recreation path



Option 3d
Two-way buffered bike lane on one side of the road with recreation path



Option 4
Two-way protected bike lanes with no recreation path



6.3 Intersection Alternatives

Intersection alternatives can be seen in **Figure 23** through **Figure 28**.

27th Street Intersection

Alternative T1 includes maintaining and optimizing the timings for the existing signal as well as capacity upgrades including dual eastbound left turn lanes, a westbound right turn lane, and the addition of an eastbound through lane.

Heritage Drive Intersection

ALTERNATIVE H1 - TRADITIONAL SIGNAL

Alternative H1 is a traditional signal with dual eastbound and westbound through lanes, eastbound left and right turn lanes, and a westbound left turn lane. Access closures and restrictions are being considered for those driveways within the influence area of the intersection including combining access, removing duplicate accesses, and restricting access to right-in right-out where needed. Raised median is provided through the functional area to aid with access management.

ALTERNATIVE H2 – CONTINUOUS GREEN T

Alternative H2 is a continuous green T with additional through/turn lanes and raised median through the functional area. Similar access closures and restrictions would be considered with this alternative as with Alternative H1. However, due to the way this intersection type operates, Right-in Right-out (RIRO) would be needed at three additional driveways.

ACCESS MANAGEMENT

The business of ‘Auto Choice’ currently leases the parcel located in the southwest quadrant of the Heritage Drive intersection. This business currently has a ROW encroachment permit, and the ROW can be used by the City at their discretion/rescind permit if ROW is needed. The City met with Auto Choice on September 7, 2023 after the second round of stakeholder meetings to discuss their concerns with the proposed sidewalk and relocation of their approach to the southern end of this parcel. Due to the parking impacts to the parcel in the southwest quadrant of Heritage Drive, the detached sidewalk along Colorado Boulevard will transition to an attached sidewalk along Heritage Drive to provide more room for parking. It was proposed to move the eastern entrance south but only far enough to meet the 95th percentile queue length of approximately 150 feet and directly across from Tractor Supply Company’s existing, northern most access. It was also determined to reduce the access width from the existing 50-foot-wide driveway down to the City’s minimum width of 25 feet. Auto Choice was okay with the arrangement, because it would gain them more parking. The City would also like to see a shared access agreement for the parcels west of Auto Choice.

The business of ‘Tractor Supply Company’ currently owns the parcel in the southeast quadrant of the Heritage Drive intersection. After meeting with Auto Choice, the City determined that Tractor Supply’s two western entrances can remain as they currently are. The northern access to Tractor Supply is a “right-out” only exit based on an agreement they have with the City. This northern access is proposed to be combined with access to the parcel to the east. Tractor Supply has

concerns with this arrangement and believes vehicles traveling from the parcel to the east will ultimately end up using their parking area to exit and gain access to Heritage Drive when Colorado Boulevard volumes increase in the future. The City plans to review the agreement they have with Tractor Supply for this northern entrance and determine if their northern exit can be eliminated and replaced with an access off of 4th Avenue instead.

The north and northeastern quadrant of Heritage Drive is currently occupied by a storage unit business. It was proposed to provide an access to this parcel via the north leg of Heritage Drive and align their eastern access with the driveway to their south. The vehicles that use their facility need a direct access in between the storage unit buildings, so this limits the amount this driveway can be moved. They would also like their access to be widened to 40-feet.

Maitland Road Intersection

Both Maitland Road intersection alternatives have been realigned to the west due to the development that is planned to take place in the northwest quadrant of this intersection. An approach to this development is required to be entirely on their property and not occupy the interstate right-of-way. Rather than having an offset approach to the west of Maitland Road in the future, the City has decided to dedicate right-of-way to the west of Maitland Road to allow for this realignment. At the time of the Study, the City owned the former sawmill property in the southwest quadrant of this intersection and was in the process of selling the property to a developer.

The two accesses to the west of Maitland Road are both closed or are planned to be closed. Both alternatives propose Fireside Place to be combined with the various retail development access. A supplemental access is proposed off of the various retail development property in order to encourage access from Maitland Road instead of Colorado Boulevard. As Colorado Boulevard volumes increase, it is expected that it will become more difficult to find adequate gaps on Colorado Boulevard to exit from this northern access.

ALTERNATIVE M1 – TRADITIONAL SIGNAL

Alternative M1 is a traditional signal with an addition of eastbound and westbound through and left turn lanes and an eastbound right turn lane. The intersection does not include any raised median.

ALTERNATIVE M2 – ROUNDABOUT

Alternative M2 is a multilane roundabout with two-lane approaches on the east/west legs and one-lane approaches on the north/south legs. Since Colorado Boulevard speeds may be higher than 40 mph, curvature and raised median have been introduced on the east/west approaches to slow down the mainline traffic prior to entering the circulating lanes of the roundabout. The roundabout was designed to accommodate a WB-67 within the inside lane. Further refinements will be required to check all sight distances within the roundabout to each movement and to each pedestrian crosswalk if this alternative moves into final design.

Similar to Alternative M1, Fireside Place is combined with the various retail development. However, this alternative causes this combined approach to become a right-in right-out. The landowner at this intersection would like to consider a secondary access to the south of this property that would connect to Maitland Road approximately one-quarter mile to the south of Colorado Boulevard in order to allow westbound-out parcel access via Maitland Road. The City

would like this to be further considered during final design. Further details from this discussion with the stakeholder can be found in the Public and Stakeholder Meeting Summary Reports provided in **Appendix B**.

Rainbow Road Intersection

ALTERNATIVE R1 – TRADITIONAL SIGNAL

Alternative R1 is a traditional signal with the addition of dual eastbound and westbound through and single left turn lanes, an eastbound right turn lane, and single northbound and southbound left turn lanes. The typical section on Colorado Boulevard narrows down to three lanes immediately east of the Rainbow Road intersection.

While northbound and southbound left turn lanes are warranted by the end of the planning horizon, widening of the north leg of the intersection to accommodate a southbound left turn lane will be limited by the I90 bridges approximately 220 feet to the north of the intersection. The I90 bridges are in good condition, and the SDDOT does not have plans for replacement of these bridges within the planning horizon of this study.

The intersection does not include any raised median. There are no accesses within the functional area of the Rainbow Road intersection and therefore no access management is planned.

ALTERNATIVE R2 – ROUNDABOUT

Similarly designed as Alternative M2, Alternative R2 is a multilane roundabout with two-lane approaches on the east/west legs and one-lane approaches on the north/south legs. The roundabout is realigned to the south in order to not encroach on interstate right-of-way. The roundabout at this location only requires a two-lane section on the north leg and therefore is not limited by the I90 bridges to the north.

Since Colorado Boulevard speeds may be higher than 40 mph, curvature and raised median have been introduced on the east/west approaches to slow down the mainline traffic prior to entering the circulating lanes of the roundabout. The roundabout was designed to accommodate a WB-67 within the inside lane. Further refinements will be required to check all sight distances within the roundabout to each movement and to each pedestrian crosswalk if this alternative moves into final design.

7.0 Build Alternative Analysis

7.1 Methodology

In order to compare the no-build and build alternatives, a traffic operations and predictive safety analysis were performed. Construction costs, right-of-way needs, landowner impacts, and environmental impacts were also estimated and quantified. Non-quantifiable factors were also considered and noted in the alternative analysis comparative methodology as well.

7.2 Build Traffic Operations

Further details of the build traffic operations analysis can be found in the *Build Condition Traffic Operations Analysis* technical memorandum provided in **Appendix H**.

Intersection Analysis

Signalized coordination along Colorado Boulevard was not assumed for signalized conditions. The intersection of Colorado Boulevard and 27th Street is coordinated with the north/south through movements for existing conditions. The north/south coordination on 27th Street was maintained for the 2035 and 2050 build conditions. Signal timings for Colorado Boulevard and 27th Street was optimized to maintain optimal traffic flow.

Future-year posted speed was assumed 45 mph on Colorado Boulevard from 27th Street to Aurora Avenue and 35 mph from Aurora Avenue to US85. This speed is typical for area urban arterial streets and allows for permitted left-turn movements in the analysis. The crossroad arterials were assumed to stay at their respective posted speed. All signalized intersections were analyzed with left turn protected-permitted phasing if left turn phasing was operationally needed.

A summary of build condition analysis results, organized by AM/PM peak hour and analysis year, for the various intersection alternatives is provided in **Table 18**.



Traffic Operations Analysis

Safety Analysis



Construction Costs

Right-of-Way Needs and Landowner Impacts



Environmental Impacts

Other Considerations



Table 18. Intersection (AM / PM) Peak Hour LOS (2050 Build)

Intersection Type	27 th Street	Heritage Drive	Maitland Road	Rainbow Road
<i>No-Build</i>	<u>F / F</u>	<u>F / F</u>	<u>F / F</u>	<u>F / F</u>
Roundabout (<i>Multilane</i>)			A / A	B / B
Signal (<i>Addition of turn lanes</i>)	C / C	B / A	B / A	B / B
Continuous Green T		B / B		

Cells noted in Orange Bold Underline correspond to where LOS does not meet acceptable thresholds.

Segment Analysis

Motorized vehicle segment operations for year 2050 Build conditions were reviewed through HCS measures in terms of travel time and segment LOS. Travel time along Colorado Boulevard through the study area is expected to be similar with traffic signals or roundabouts at Maitland Road and Rainbow Road. Analysis results for the roadway segments are provided in **Table 19**.

Table 19. Colorado Boulevard LOS (AM / PM) and Travel Time (2050 Build)

From	To	Highway Type	AM LOS		PM LOS	
			EB	WB	EB	WB
27 th Street	Heritage Drive	Multilane	C	C	B	C
Heritage Drive	Maitland Road	Multilane	A	A	A	A
Maitland Road	Rainbow Road	Multilane	A	A	A	A
Rainbow Road	Colorado Loop	Two-lane	A	A	A	A
Travel Time (27 th Street to Colorado Loop)			6 min, 8 sec	6 min, 12 sec	6 min, 5 sec	6 min, 8 sec

Cells noted in Orange Bold Underline correspond to where LOS does not meet acceptable thresholds.

Multimodal Analysis

Multimodal elements were included in build condition HCS Streets files when supported by methodology and software. Pedestrian and bicycle facility assumptions include:

- Shared-use path on north or south side of Colorado Boulevard corridor for pedestrians and bicyclists
- Connectivity with other sidewalks and shared use paths crossing the study corridor
- Crosswalks across all signalized and roundabout intersection legs (provide for all movements)
- Dedicated on-street bicycle facilities (bike lanes) for eastbound and westbound travel

The potential multimodal improvements incorporated into the analysis provide acceptable LOS scores of LOS C or better at both intersections and along corridor segments. Key components to these scores include:

- Recreation path on one side and sidewalk on other that provides adequate space for multimodal users
- Wide boulevard that maximizes separation between travel way and multimodal facilities
- Intersection volumes and turn conflicts; increasing intersection volumes will be expected to lower LOS scores as vehicle/pedestrian conflict exposure increases in intersection crosswalks

COLORADO BOULEVARD & 27TH STREET LEADING PEDESTRIAN INTERVAL

A sensitivity analysis of 2050 Build conditions was conducted for the intersection of Colorado Boulevard & 27th Street to determine the impacts of a Leading Pedestrian Interval (LPI). LPI is a traffic signal timing feature that enhances pedestrian safety at signalized intersections. The LPI works when the pedestrian signal turns green a few seconds before the corresponding vehicular signal turns green which allows pedestrians to enter the crosswalk and establish their presence before vehicles are allowed to make their turns or proceed through the intersection. This enables pedestrians the right-of-way to start crossing the street before vehicles are given the right-of-way to move.

The Colorado Boulevard & 27th Street sensitivity analysis for a LPI identified that the signal operations would operate with slightly more delay but still operate at an acceptable LOS C threshold. Signal timings could be updated to give less green time to the eastbound and westbound movements so that operations and movements are not impacted at the nearby intersection of I90 & 27th Street. SDDOT plans to include a LPI at this intersection in the near future.

Traffic Operations Summary of Findings

COLORADO BOULEVARD: 27TH STREET TO RAINBOW ROAD

A multilane Colorado Boulevard section, two lanes in each direction plus intersection improvements, would address operational needs at major intersections through year 2050. Intersection improvements include changes in traffic control and/or incorporating left and right-turn lanes.

Roundabouts are expected to provide slightly better operations at the Maitland Road and Rainbow Road intersections compared to signalized intersections. Continuous Green T configuration at Colorado Boulevard & 27th Street operates with more delay when compared to a signalized intersection and presents a potential weaving issue due to the close proximity between the Heritage Drive and 27th Street intersections.

COLORADO BOULEVARD: RAINBOW ROAD TO COLORADO LOOP

A single through lane in each direction plus intersection improvements were found to address operational needs at major intersections through year 2050. Intersection improvements include changes in traffic control and/or incorporating left and right-turn lanes.

7.3 Safety Analysis

The roadway segment and intersection alternatives were compared using the Highway Safety Manual's (HSM) predictive safety analysis methodology. The safety of the recreation path alternatives were compared by estimating the vehicle-pedestrian conflict points and driveway vehicle volumes.

Predictive Safety Analysis

In order to compare the build roadway segment and intersection alternatives, a quantitative safety analysis of the proposed improvements was completed for both the no-build and build alternatives. The predictive crash analysis is based on the principles and methods of the HSM 2010 edition with 2014 supplement published by American Association of State Highway and Transportation Officials (AASHTO). It presents a comparative analysis of the predicted crashes anticipated within the study area for the No-Build and Build alternatives. Based on the HSM analysis, the following conclusions have been reached for the various corridor and intersection No-Build and Build Alternatives. Further details can be found in the *Predictive Safety Analysis technical memorandum* provided in **Appendix I**.

NO-BUILD ALTERNATIVE - MULTILANE SENSITIVITY ANALYSIS

For the No-Build condition, two scenarios were modeled including the No-Build alternative (2-lane corridor), which matches existing conditions, and the No-Build Multilane Sensitivity Analysis alternative (multilane corridor, 3-lane, and 2-lane corridor), which simulates additional lanes, similar to the Build alternatives, with no other corridor changes. The No-Build Multilane Sensitivity Analysis alternative was included to showcase the modeling differences between roadway facility types with lesser and greater capacity (e.g. a 2-lane versus 5-lane arterial roadway) as the facilities with greater capacity tend to have higher predicted crash rates. This can pose a potential issue when modeling as the No-Build alternative will indicate fewer predicted crashes but does not consider the unacceptable levels of traffic operations anticipated for Colorado Boulevard based on the analysis conducted in the Spearfish Colorado Boulevard Existing and Future No-Build Condition Intersection Traffic Operations Analysis Technical Memo and the Spearfish Colorado Boulevard Existing and Future Build Condition Intersection Traffic Operations Analysis Technical Memo. The addition of the multilane sensitivity analysis allows for a supplemental comparison between the No-Build and Build alternatives as it encompasses the capacity needs to meet traffic operational goals in the future.

COLORADO BOULEVARD ROADWAY SEGMENTS

Using the No-Build Alternative Multilane Sensitivity Analysis, all build alternatives are predicted to reduce roadway segment crashes by -11% to -14% fatal and injury crashes and -8% to -13% total crashes compared to the No-Build alternative.

COLORADO BOULEVARD & US14A / 27TH STREET INTERSECTION

Build Alternative T1 (Traditional signalized intersection) is predicted to have a slight decrease in total crashes with approximately two fewer crashes (-5%) compared to the No-Build alternative.

COLORADO BOULEVARD & HERITAGE DRIVE INTERSECTION

Build Alternative H1 (Traditional Signalized intersection) and H2 (CGT intersection) both provide reductions in total crashes with 16 to 24 fewer crashes (-25% to -37%) compared to the No-Build alternative. Build Alternative H2 (CGT intersection) provides the greatest reduction in total crashes with 24 fewer crashes (-37%) compared to the No-Build alternative.

COLORADO BOULEVARD & MAITLAND ROAD INTERSECTION

Build Alternative M1 (Traditional Signalized intersection) provides a slight reduction in total crashes with two fewer crashes (-5%) compared to the No-Build alternative. Build Alternative M2 (Two-Lane Roundabout intersection) ranges from a decrease in total crashes with 10 fewer crashes (-19%, single-lane roundabout analysis) to an increase with two more crashes (+5%, multilane roundabout analysis) compared to the No-Build alternative.

COLORADO BOULEVARD & RAINBOW ROAD INTERSECTION

Build Alternative M1 (Traditional Signalized intersection) and Build Alternative M2 (Two-Lane Roundabout intersection, analyzed as a single-lane roundabout) provide similar reductions in total crashes with 26 fewer crashes (-39%) compared to the No-Build alternative. Build Alternative M2 (Two-Lane Roundabout intersection), analyzed as a multilane roundabout, provides a smaller reduction in total crashes than Build Alternative M1 or M2 with 17 fewer crashes (-25%) compared to the No-Build alternative.

Recreation Path Conflict Point Comparison

The highway safety manual doesn't currently have a predictive safety analysis for crashes involving pedestrian or bicyclists at uncontrolled intersections. However, a means of comparing the safety of the recreation path alternatives in a quantitative way was needed. The number of conflict points and vehicular volumes crossing through those conflict points at an intersection generally correlates with the amount of exposure a vehicle, bicyclist, or pedestrian has as they enter an intersection. The higher the exposure, the higher chances of a crash. The number of entry and exit conflict points and their associated vehicular volumes were quantified for all present and future accesses along the north and south side of the corridor. As shown in **Table 20**, the number of entry/exit conflict points depend on the type of access and turning movements allowed to enter/exit. **Figure 32** visually demonstrates how access restrictions reduce the number of conflict points. The conflict points are represented by a black 'x' in the figure.

Table 20. Types of access points and associated entry/exit conflict points

Type of Access	Entry Conflict Points	Exit Conflict Points
T-driveway	2	2
T-driveway w/ raised median	1	1
4-way-driveway	3	3

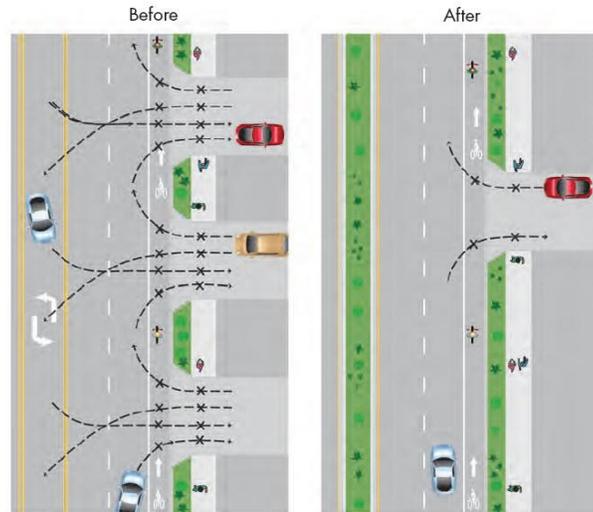


Figure 32. Conflict Points at a standard T-driveway with and without raised median¹⁴

As shown in **Table 21**, the number of conflict points and crossing vehicle volumes are significantly higher for the south path compared to the north path. This suggests that the north path may have less pedestrian and bicycle crashes within the planning horizon compared to the south path.

Table 21. Uncontrolled & Controlled Intersection Conflict Points and Crossing Vehicle Volumes

Path Segment	North Path Conflict Points	South Path Conflict Points	Difference	North Path Crossing Vehicles	South Path Crossing Vehicles	Difference
Total Segment 1	34	60	76%	11800	36620	210%
Total Segment 2	12	44	267%	2255	9030	300%
Total Segment 3	20	42	110%	13000	16370	26%

7.4 Comparative Construction Costs

All construction costs are for planning purposes only and should be further refined in the final design process. Further details regarding estimated quantities, cost data, and assumptions for the comparative planning level cost estimates can be found in **Appendix J**.

Roadway Segment Costs

Estimated roadway segment construction costs are summarized in **Table 22**. For comparison purposes, all roadway segment costs assume the north recreation path alternative with sidewalks as needed on the south side of the road and in-street buffered bike lanes. Intersection costs are excluded from the roadway segment cost estimates and can be added to the roadway segment cost estimates for a more comprehensive project cost.

¹⁴ Illustration by Michele Weisbart, Model Design Manual for Living Streets

Segment 1 features a 5-lane urban section between Heritage Drive and Maitland Road. This segment is expected to be one of the most expensive segments to construct due to the False Bottom Creek Structure replacement. It is also expected that this segment will require some sort of retaining wall between the interstate to the north, Colorado Boulevard, and businesses to the south, roughly one-third of a mile to the east of Heritage Drive. A retaining wall or similar structure would reduce impacts to the I90 drainage ditch situated below and private business parking area impacts situated above Colorado Boulevard.

Segment 2 features a 5-lane urban section between Maitland Road to Rainbow Road. Roadway costs between Segment 1 and 2 are very similar with the main difference being less approaches to reconstruct on Segment 2. Segment 2 is broken down into two separate alternatives dependent on whether a pedestrian underpass is provided at Tetro Creek.

Segment 3 and 4 feature a 3-lane urban section between Rainbow Road and Aurora Avenue. These two segments don't include any major drainage structures and have a more narrow roadway width, so they are expected to be the least expensive segments to construct. Segment 4 stops short of the Miller Creek structure which will get replaced as a separate project. Costs were included for a rectangular rapid flashing beacon at Colorado Loop to aid in the pedestrian crossings that are expected to occur between the Sky Ridge residential development/sports complex and the convenience store at the Travel Center.

Table 22. Planning-Level Roadway Segment Construction Costs

Road Segment	Number of Lanes	Segment Length (Miles)	Roadway Cost (\$2023)	Structure Cost (\$2023) ¹	Total Comparative Construction Costs (\$2023)
Segment 1 (Heritage Dr to Maitland Rd)	5-Lane	0.8	\$6.1 M	\$8.4 M	\$14.5 M
Segment 2 (Maitland Rd to Rainbow Rd)	5-Lane	0.8	\$6.0 M	\$0.9 M	\$6.1 M
	5-Lane w/ Tetro Creek Ped Underpass		\$6.0 M	\$1.6 M	\$7.6 M
Segment 3 (Rainbow Rd to Aurora Ave)	3-Lane	0.7	\$4.2 M	-	\$4.2 M
Segment 4 (Aurora Ave to Colorado Lp)	3-Lane	0.6	\$4.0 M	-	\$4.0 M

¹Structure costs denote bridges or box culvert costs.

Intersection Costs

Estimated intersection construction costs are summarized in **Table 23**. For comparison purposes, all intersection costs assume the north recreation path alternative with sidewalks as needed on the south side of the road and in-street buffered bike lanes (Option 3c).

All cost estimates assume full reconstruction except at the 27th Street intersection. Since the Colorado Boulevard & 27th Street intersection was recently reconstructed in 2018, it was assumed this intersection would be widened to provide necessary capacity improvements.

The traditional signal (H1) and continuous green T (H2) at the Colorado Boulevard and Heritage Drive intersection is expected to be similar in total costs. The roundabout (M2) is expected to be \$500,000 more to construct compared to the traditional signal (M1) at Maitland Avenue. The roundabout has a larger footprint and therefore more pavement needed to construct.

Whereas the roundabout (R2) is expected to be \$300,000 less than the traditional signal (R1) at the Rainbow Road intersection. The roundabout (R2) has a larger footprint at the core of the intersection. However, a traditional signal (R1) at this location warrants northbound and southbound left turn lanes by the end of the planning horizon. Due to the left turn bay storage length, bay taper, and departure taper, the traditional signal has a larger footprint overall and therefore has a higher overall cost in comparison to the roundabout alternative. This cost estimate does not include the costs of having to reconstruct the I90 bridges immediately to the north of the Rainbow Road intersection.

Table 23. Planning-Level Intersection Construction Costs

Intersection	Build Alternative	Comparative Cost Estimate (\$2023)
Colorado Boulevard & 27 th Street	T1 - Traditional Signal	\$1.4 Million
Colorado Boulevard & Heritage Drive	H1 - Traditional Signal	\$2.5 Million
	H2 - Continuous Green T	\$2.5 Million
Colorado Boulevard & Maitland Road	M1 - Traditional Signal	\$2.2 Million
	M2 - Roundabout	\$2.7 Million
Colorado Boulevard & Rainbow Road	R1 - Traditional Signal	\$3.8 Million
	R2 - Roundabout	\$3.5 Million

Recreation Path Costs

Estimated recreation path costs are summarized in **Table 24**. Total path segment costs were converted to a unit of a dollar per mile in order to compare costs between segments. For comparison purposes, the only costs included in the estimate comprise of the recreation path, sidewalk, retaining walls, and supplementary bridge width required for that particular alternative.

The north alternative of Segment 1 and 2 is roughly \$500,000 and \$300,000 more than the South alternative, respectively. The main cause of this is the additional sidewalk needed on the south side of the roadway along the existing developments in addition to the recreation path on the north side. Having the recreation path on the south side of the road serves as both the recreation path and providing local pedestrian access to the businesses.

The off-alignment alternative costs are provided for inclusiveness. However, there would presumably be additional costs associated with this alternative that are unquantifiable at this time including what would be required to be constructed/reconstructed for the associated side road.

Table 24. Planning-Level Recreation Path Construction Costs

Path Segment	Segment Length (Miles)	Recreation Path Side	Total Segment Cost (\$2023)	Unit Cost (\$2023/Mile)
Segment 1 (27th Street to east of False Bottom)	0.9	North	\$ 2.2 M	\$ 2.5 M
		South	\$ 1.7 M	\$ 1.9 M
		Off Alignment	\$ 1.8 M	\$ 2.0 M
Segment 2 (east of False Bottom to Rainbow Rd)	1.3	North	\$ 1.3 M	\$ 1.0 M
		South	\$ 1.0 M	\$ 0.7 M
		Off Alignment	\$ 1.3 M	\$ 1.0 M
Segment 3a (Rainbow Road to Aurora Ave)	0.9	North	\$ 1.0 M	\$ 1.0 M
		South	\$ 0.7 M	\$ 0.7 M
		Off Alignment	\$ 1.0 M	\$ 1.0 M
Segment 3b (Aurora Ave to Colorado Loop)	0.6	North	\$ 0.5 M	\$ 0.7 M
		South	\$ 0.5 M	\$ 0.8 M
		Off Alignment North	\$ 0.7 M	\$ 1.1 M
		Off Alignment South	\$ 1.2 M	\$ 2.0 M

In-Street Bike Facility Costs

Estimated in-street bike facility costs are summarized in **Table 25**. In-street bike facility costs were totaled for the entire length of the corridor and converted to an average unit dollar per mile in order to compare costs between options. For comparison purposes, quantities do not include baseline roadway costs and the only costs included in the estimate comprise of the in-street bike facility pavement, recreation path (if present), sidewalk, curb and gutter, median, and supplementary bridge/box culvert width required for that particular option.

Table 25. Planning-Level In-Street Bike Facility Construction Costs

In-Street Option	Total Cost for Entire Corridor (\$2023)	Average Construction Unit Cost (\$2023/Mile)
Option 1 – No bike lanes with the recreation side path	\$6.4 M	\$1.7 M
Option 2 – Conventional bike lanes with the recreation side path	\$9.0 M	\$2.3 M
Option 3a – One-way buffered bike lanes on either side of road with no recreation path	\$6.9 M	\$1.8 M
Option 3b – Two-way buffered bike lane on one side of the road with no recreation path	\$6.4 M	\$1.7 M
Option 3c – One-way buffered bike lane on both sides of the road with recreation path	\$9.5 M	\$2.5 M
Option 3d – Two-way buffered bike lane on one side of the road with recreation path	\$9.5 M	\$2.5 M
Option 4 – Two-way protected bike lanes with no recreation path	\$9.8 M	\$2.5 M

7.5 Right-of-Way Needs

Right-of-way needs were estimated using the roadway and intersection layouts, preliminary corridor model grading limits, locations where retaining wall and large embankments were needed, and large drainage or pedestrian underpass structures. Temporary easement will be needed beyond the right-of-way acquisition for construction purposes and has not been included in the estimated areas below.

Roadway Segments

The existing right-of-way is primarily 100 feet wide for the majority of the corridor, except for a short length of corridor that narrows to 82' within Segment 4. This right-of-way width should be adequate for the 3-lane and 5-lane typical section for the majority of the corridor. Additional right-of-way may be needed at locations of drainage structures, pedestrian underpasses, and large embankments. Right-of-way needs were estimated for each roadway segment in **Table 26**. For comparison purposes, all roadway segment right-of-way acquisition was estimated assuming the north recreation path alternative with sidewalks as needed on the south side of road and in-street buffered bike lanes (Option 3c).

Segment 2 will need right-of-way acquisition at the Tetro Creek pedestrian underpass. Segment 4 will need additional right-of-way where the existing width is less than 100-feet.

Table 26. Estimated Roadway Segments Right-of-Way Needs

Road Segment	Number of Lanes	ROW Acquisition (Acres)
Segment 1 (Heritage Dr to Maitland Rd)	5-Lane	0.00
Segment 2 (Maitland Rd to Rainbow Rd)	5-Lane	0.00
	5-Lane w/ Tetro Creek Ped Underpass	0.36
Segment 3 (Rainbow Rd to Aurora Ave)	3-Lane	0.00
Segment 4 (Aurora Ave to Colorado Lp)	3-Lane	0.19

Intersections

Right-of-way needs were estimated for each intersection alternative and summarized in **Table 27**. For comparison purposes, all intersection right-of-way acquisition was estimated assuming the north recreation path alternative with sidewalks as needed on the south side of road and in-street buffered bike lanes (Option 3c).

All intersections were designed to accommodate a WB-67 truck. At the traditional signal intersection alternatives, the majority of the intersection right-of-way needs are coming from the improvements needed to accommodate these large intersection radii. The two roundabout alternatives require a significant amount of right-of-way compared to the traditional signal alternatives.

Table 27. Estimated Intersection Right-of-Way Needs

Intersection	Build Alternative	ROW Acquisition (Acres)
Colorado Boulevard & 27 th Street	T1 - Traditional Signal	0.00
Colorado Boulevard & Heritage Drive	H1 - Traditional Signal	0.02
	H2 - Continuous Green T	0.02
Colorado Boulevard & Maitland Road	M1 - Traditional Signal	0.06
	M2 - Roundabout	0.58
Colorado Boulevard & Rainbow Road	R1 - Traditional Signal	0.0
	R2 - Roundabout	0.81

Recreation Path

Right-of-way needs were estimated for each path alternative and summarized in **Table 28**. For comparison purposes, all recreation path right-of-way acquisition was estimated assuming the traditional signalized intersection alternatives. Right-of-way acquisition was not estimated for the off-alignment options because of the many unknowns surrounding this alternative.

Right-of-way needs are estimated to be similar between the north and south recreation path alternatives. However, since the south path does not require sidewalk for the majority of the north side of the roadway, it can be assumed that the south path would fit within the existing right-of-way width to a better extent.

Table 28. Estimated Recreation Path Right-of-Way Needs

Path Segment	Recreation Path Side	ROW Needs (Acres)
Segment 1 (27th Street to east of False Bottom)	North	0.02
	South	0.02
	Off Alignment	(1)
Segment 2 (east of False Bottom to Rainbow Rd)	North	0.83
	South	0.86
	Off Alignment	(1)
Segment 3a (Rainbow Road to Aurora Ave)	North	0.00
	South	0.00
	Off Alignment	(1)
Segment 3b (Aurora Ave to Colorado Loop)	North	0.19
	South	0.19
	Off Alignment North	(1)
	Off Alignment South	(1)

(1) ROW and environmental impact data unavailable for the off-alignment options.

7.6 Environmental Screening

An Environmental Screening Report for the Colorado Boulevard area was completed to identify environmental resources, potential for impacts, and future actions needed as part of the project. The Environmental Screening Report, included in **Appendix D**, documents findings from the review. Figures illustrating environmental resources can also be found with the report.

Wetland impacts were estimated for intersection alternatives using desktop resources and summarized in **Table 29**. For comparison purposes, wetland impacts at the intersections were estimated assuming the north recreation path alternative with sidewalks as needed on the south side of road and in-street buffered bike lanes (Option 3c). Intersections were not adjacent to any known 100-year floodplain, so floodplain impacts were not estimated.

Table 29. Estimated Intersection Wetland Impacts

Intersection	Alternative No. & Description	Wetland Impacts (Acres)
27th St Intersection	Traditional Signal with Capacity Improvements	0.01
Heritage Dr Intersection	Alternative 1 - Traditional Signal	0.00
	Alternative 2 - Continuous Green T	0.00
Maitland St Intersection	Alternative 1 - Traditional Signal	0.06
	Alternative 2 - Roundabout	0.07
Rainbow Rd Intersection	Alternative 1 - Traditional Signal	0.00
	Alternative 2 - Roundabout	0.00

Wetland and floodplain impacts were estimated for the north and south recreation path alternatives in **Table 30**. For comparison purposes, wetland and floodplain impacts were estimated assuming the traditional signalized intersection alternatives and in-street buffered bike lanes (Option 3c). Impacts were not estimated for the off-alignment alternatives because of the many unknowns surrounding this alternative.

Table 30. Estimated Wetland Impacts for Path Alternatives

Path Segment	Recreation Path Side	Wetland Impacts (Acres)	Floodplain Impacts (Acres)
Segment 1 (27th Street to east of False Bottom)	North	0.13	0.31
	South	0.07	0.35
	Off Alignment	(1)	(1)
Segment 2 (east of False Bottom to Rainbow Rd)	North	0.88	0.08
	South	0.90	0.09
	Off Alignment	(1)	(1)
Segment 3a (Rainbow Road to Aurora Ave)	North	0.78	-
	South	0.70	-
	Off Alignment	(1)	(1)
Segment 3b (Aurora Ave to Colorado Loop)	North	0.75	0.08
	South	0.68	0.07
	Off Alignment North	(1)	(1)
	Off Alignment South	(1)	(1)

Cultural surveys must be completed within project limits once recommendations are known to determine full impacts to archaeological and historic properties. The off alignment shared use path build alternative would likely have a greater impact on land within the Frawley Ranch National Historic Landmark, this area has been previously disturbed by agricultural and construction activities.

Threatened and endangered species habitat in the area is limited, and build alternatives are not anticipated to remove significant habitat for those species. Surveys and additional coordination with USFWS regarding the NLEB may be required to be conducted at bridge locations within the study area prior to construction in order to minimize potential impacts to the species.

7.7 Summary of Advantages and Disadvantages

Comparison matrices of all roadway segment, intersection, and recreation path alternatives can be found in **Appendix K**. These matrices summarize all of the traffic operations, predictive safety, construction cost estimate, ROW needs, landowner impacts, and other considerations. In order to focus on the key considerations for the intersection and recreation path alternatives, advantages and disadvantages are summarized in the subsequent tables.

Intersection Alternatives

HERITAGE DRIVE INTERSECTION

The advantages and disadvantages of alternative H1 and H2 are listed in **Table 31** and **Table 32**, respectively.

Table 31. Heritage Drive - H1 Traditional Signal – Advantages and Disadvantages

Advantages	Disadvantages
Familiar intersection type.	Right-in-Right-out at 2 driveways.
Provides opportunity for passenger cars to turn around.	
Pedestrian crosswalks across both Colorado Blvd. and Heritage Dr.	

Table 32. Heritage Drive - H2 Continuous Green T – Advantages and Disadvantages

Advantages	Disadvantages
Westbound traffic doesn't need to stop.	Right-in-Right-out at five driveways.
	No pedestrian crosswalk across Colorado Blvd.
	Presents a potential weaving issue for westbound traffic.
	Operates with more delay than signalized intersection.

MAITLAND ROAD INTERSECTION

The advantages and disadvantages of alternative M1 and M2 are listed in **Table 33** and **Table 34**, respectively.

Table 33. Maitland Road – M1 Traditional Signal – Advantages and Disadvantages

Advantages	Disadvantages
Familiar intersection type.	Not enough space for large truck turn around.
Less expensive than roundabout.	Longer ped crosswalk distances.
	Higher fatal and injury crashes compared to roundabout.

Table 34. Maitland Road – M2 Roundabout – Advantages and Disadvantages

Advantages	Disadvantages
Space for large truck turn around.	Right-in-Right-out for parcel access to SE of intersection.
Traffic calming.	More expensive than signal.
Reduced fatal and injury crashes compared to traditional signal.	Larger intersection footprint.
Reduced ped crossing distances.	

RAINBOW ROAD INTERSECTION

The advantages and disadvantages of alternative R1 and R2 are listed in **Table 35** and **Table 36**, respectively.

Table 35. Rainbow Road – R1 Traditional Signal – Advantages and Disadvantages

Advantages	Disadvantages
Familiar intersection type.	Requires I90 bridge replacements if NB/SB turn lanes were added.
Smaller intersection footprint.	Not enough space for large truck turn around.
	Longer ped crosswalk distances.
	Higher fatal and injury crashes compared to roundabout.
	More expensive than roundabout.

Table 36. Rainbow Road – R2 Roundabout – Advantages and Disadvantages

Advantages	Disadvantages
Space for large truck turn around.	Larger intersection footprint.
Traffic calming.	More ROW acquisition required.
Reduced fatal and injury crashes compared to traditional signal.	
Reduced ped crossing distances.	
Less expensive than signal.	

Recreation Path Alternatives

The advantages and disadvantages of the north, south, and off-alignment recreation path alternatives are summarized in **Table 37**.

Table 37. Recreation Path Alternatives – Advantages and Disadvantages

Path Segment	Recreation Path Side	Advantages	Disadvantages
Segment 1 (27th St. to east of False Bottom)	North	Significantly less driveways and conflict points for bicyclists and pedestrians.	Roughly \$500K more expensive than south option.
	South	Located on the side of the road with businesses and intersecting roads. No need for sidewalk on the north side. This alternative better fits within the existing ROW width.	Significantly more driveways and conflict points for bicyclists and pedestrians.
	Off Alignment	Potentially lower level of ped/bike stress.	Out of way travel required. Delayed construction since secondary east-west roadway is developer driven.
Segment 2 (east of False Bottom to Rainbow Rd.)	North	Significantly less driveways and conflict points for bicyclists and peds.	Roughly \$300K more expensive than south alternative.
	South	Located on the side of the road with businesses and intersecting roads. No need for sidewalk on the north side.	
	Off Alignment	Potentially lower level of ped/bike stress.	Out of way travel required. Delayed construction since secondary east-west roadway is developer driven.
Segment 3a (Rainbow Rd. to Aurora Ave.)	North	Less driveways and conflict points for bicyclists and pedestrians.	Roughly \$300K more expensive than south alternative.
	South	Located on the side of the road with businesses and intersecting roads. No need for sidewalk on the north side.	
	Off Alignment	Potentially lower level of ped/bike stress.	Out of way travel required. Delayed construction since secondary east-west roadway is developer driven.
Segment 3b (Aurora Ave. to Colorado Lp.)	North	Slightly less driveways and conflict points for bicyclists and pedestrians.	
	South	Located on the side of the road with businesses and intersecting roads. No need for sidewalk on the north side.	
	Off Alignment North	Potentially lower level of ped/bike stress.	Out of way travel required.
	Off Alignment South	Potentially lower level of ped/bike stress.	Out of way travel required.

8.0 Future Roadway and Multimodal Network

A future roadway network and multimodal network plan provides a framework for future development, supports the City's access spacing standards, and summarizes the public's desires for a walkable and bikeable community. These network plans were developed starting with previous transportation plans including the Spearfish Master Transportation Plan and Spearfish's Parks and Recreation Master Plan. The network plans focused on the surrounding area of Colorado Boulevard and were amended based on the needs identified as part of the existing conditions analysis of this study and refined from input from the Study Advisory Team, stakeholders, and the public. The future roadway network and future multimodal network plans are shown in **Figure 33** and **Figure 34**.

Future roadways shown on this map would be primarily development driven and would be a starting point during the platting and development permitting process. The connection of Centennial Road to Maitland Road was revised to take into account the topography of the area. A future east-west collector road about a quarter mile south was added to provide a secondary means to travel east-west. The addition of north-south collector roads spaced every one-quarter mile will allow developers to meet access spacing standards for arterial and collector roads. Leaving Colorado Boulevard as an arterial roadway that prioritizes mobility and the collector roads to balance mobility with access. The city plans to amend the Spearfish Master Transportation Plan with these two network plans.

9.0 Recommendations and Implementation Timelines

9.1 Recommendations

Intersections and Roadway Segments

Ultimately, the SAT preferred intersection and roadway segment alternatives are summarized in **Table 38** and displayed in **Figure 35** through **Figure 40**.

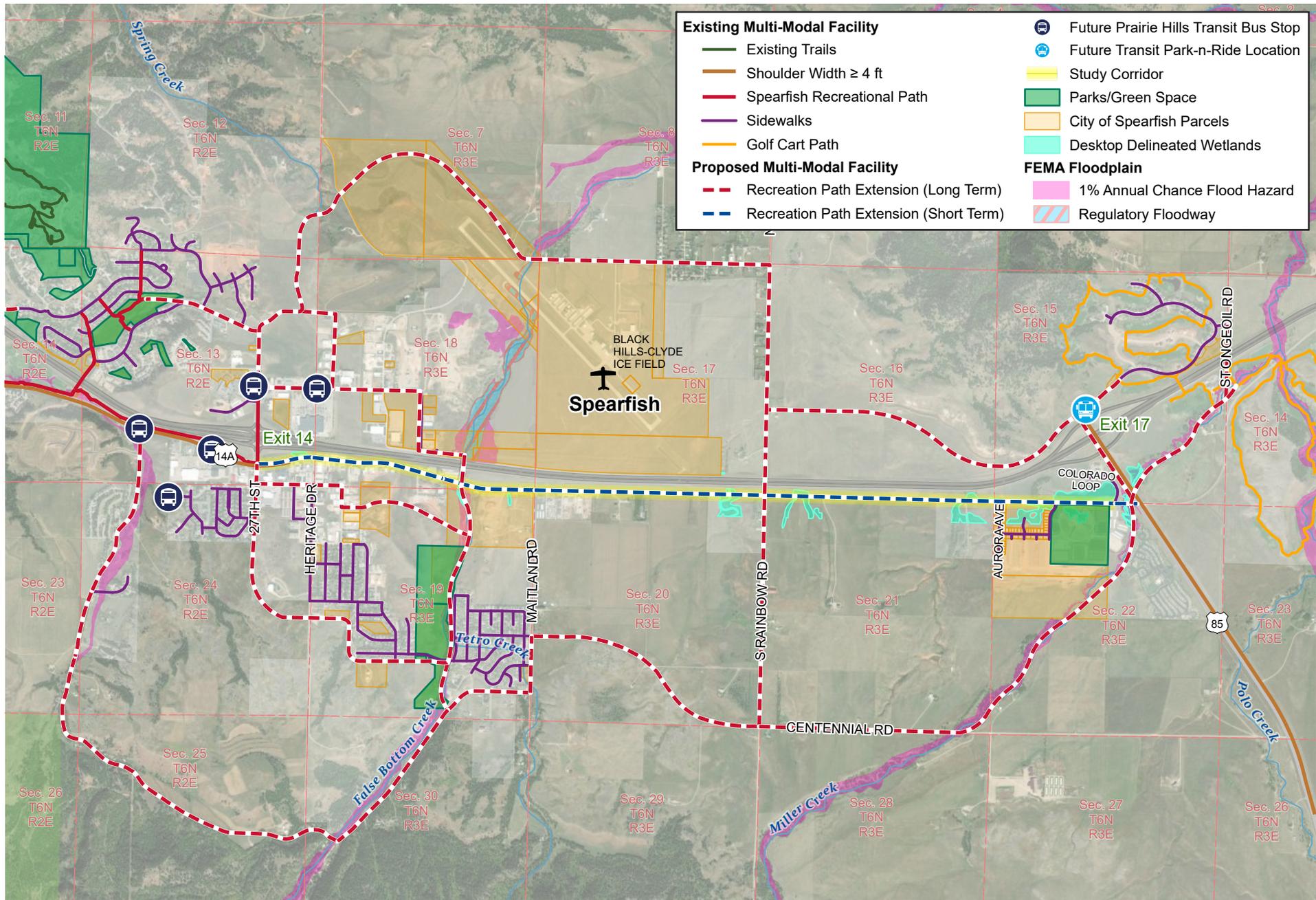
Table 38. Summary of Preferred Intersection and Roadway Segment Alternatives

Intersection	Improvement Type
27th Street Intersection	Traditional Signal - Intersection Capacity Improvements Only
Heritage Drive Intersection	Traditional Signal
Road Segment 1 - Heritage Drive to Maitland Road	5 Lane Section w/ Pedestrian Underpass at False Bottom Creek
Maitland Road Intersection	Roundabout
Road Segment 2 - Maitland Road to Rainbow Road	5 Lane Section w/ Pedestrian Underpass at Tetro Creek
Rainbow Road Intersection	Roundabout
Road Segment 3 - Rainbow Road to Aurora Avenue	3 Lane Section
Road Segment 4 - Aurora Avenue to Colorado Loop	3 Lane Section w/ Pedestrian Underpass at Miller Creek (Separate Structure Project)

The traditional signal was the preferred alternative at Heritage Drive because of the reduced business access impacts, the CGT presented a potential weaving issue and operated with more delay, the need for pedestrian crosswalks across both Colorado Boulevard and Heritage Drive, and the ability for passenger cars to be able to turn around.

Both of the alternatives at Maitland Road had merit. The signal had a lower cost and smaller intersection footprint. The roundabout has a higher initial cost but will have less maintenance costs throughout its lifecycle. The public input received was largely in favor of the roundabout at this location. The roundabout also allowed for large trucks to turn around, a lower fatal and injury crash rate compared to a signal, shorter pedestrian crosswalk distances, and provide traffic calming effects. For these reasons, the roundabout alternative was the preferred alternative. The SAT wanted to further investigate in final design the ability to connect Fireside Place to Maitland Road south of Sodak Storage LLC to allow motorists to head westbound out of this parcel. They also wanted to consider purchasing the land on the northeast side of the roundabout, because the landowner has concerns that this alternative would cause this part of his parcel to become an economic remanent.

The roundabout was the preferred alternative at Rainbow Road mainly due to the traditional signal's need for a southbound left turn lane at the end of the planning horizon resulting in potential I90 bridge replacement. Other reasons the SAT preferred the roundabout include the public input being largely in favor of a roundabout at this location, the lower overall lifecycle costs, the ability for drivers to make a U-turn, the traffic calming effects, lower fatal/injury crashes compared to a signal, and the shortened pedestrian crosswalk distances. The City would like to plan ahead at this parcel and purchase the property in the southwest and southeast quadrant prior to the parcels developing.



EXISTING AND PROPOSED MULTI-MODAL FACILITY NETWORK

Figure 34



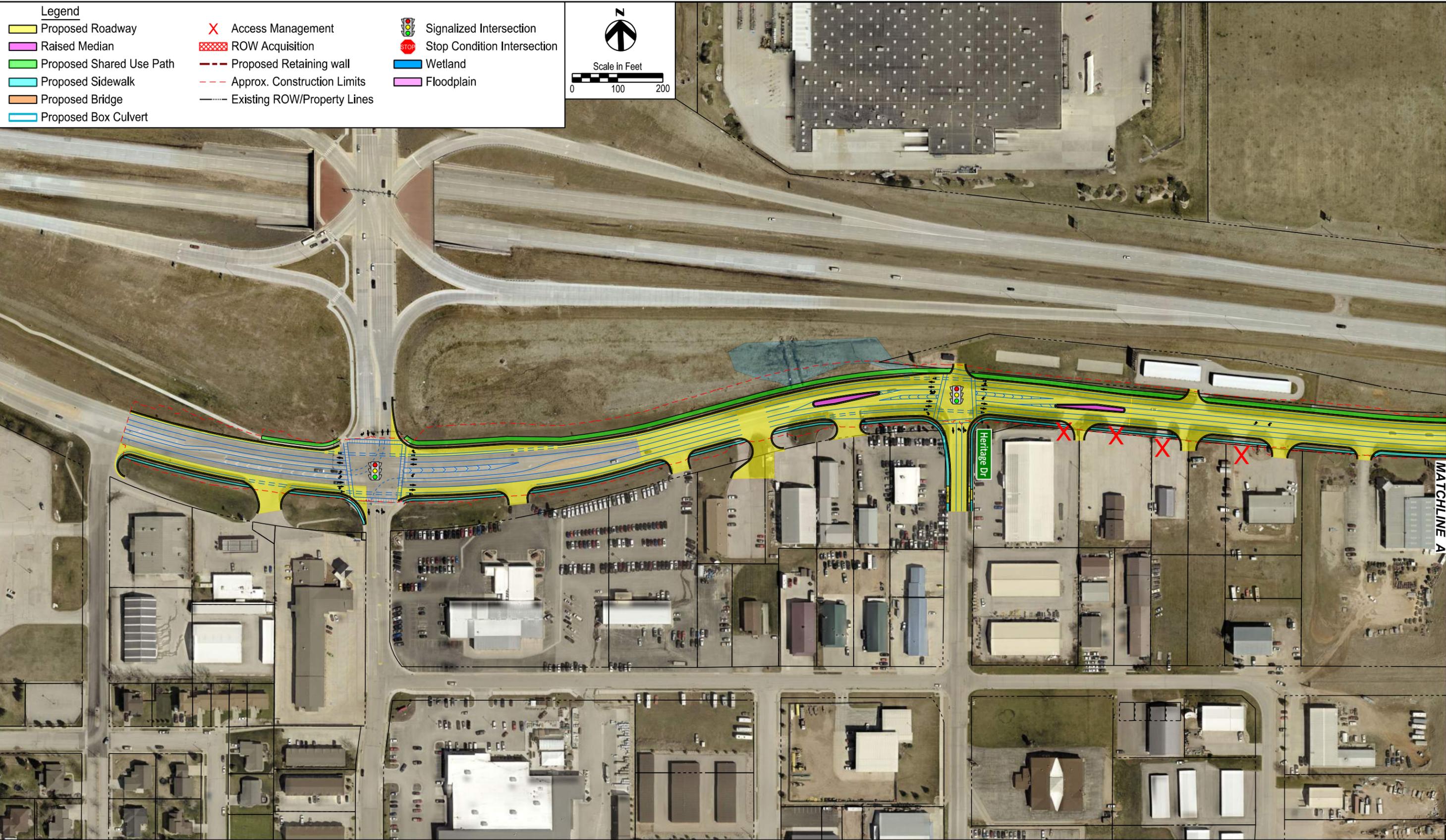


FIGURE 35

Revision:



Colorado Blvd Improvements - 27th St to East of Heritage Dr

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Figure #

35

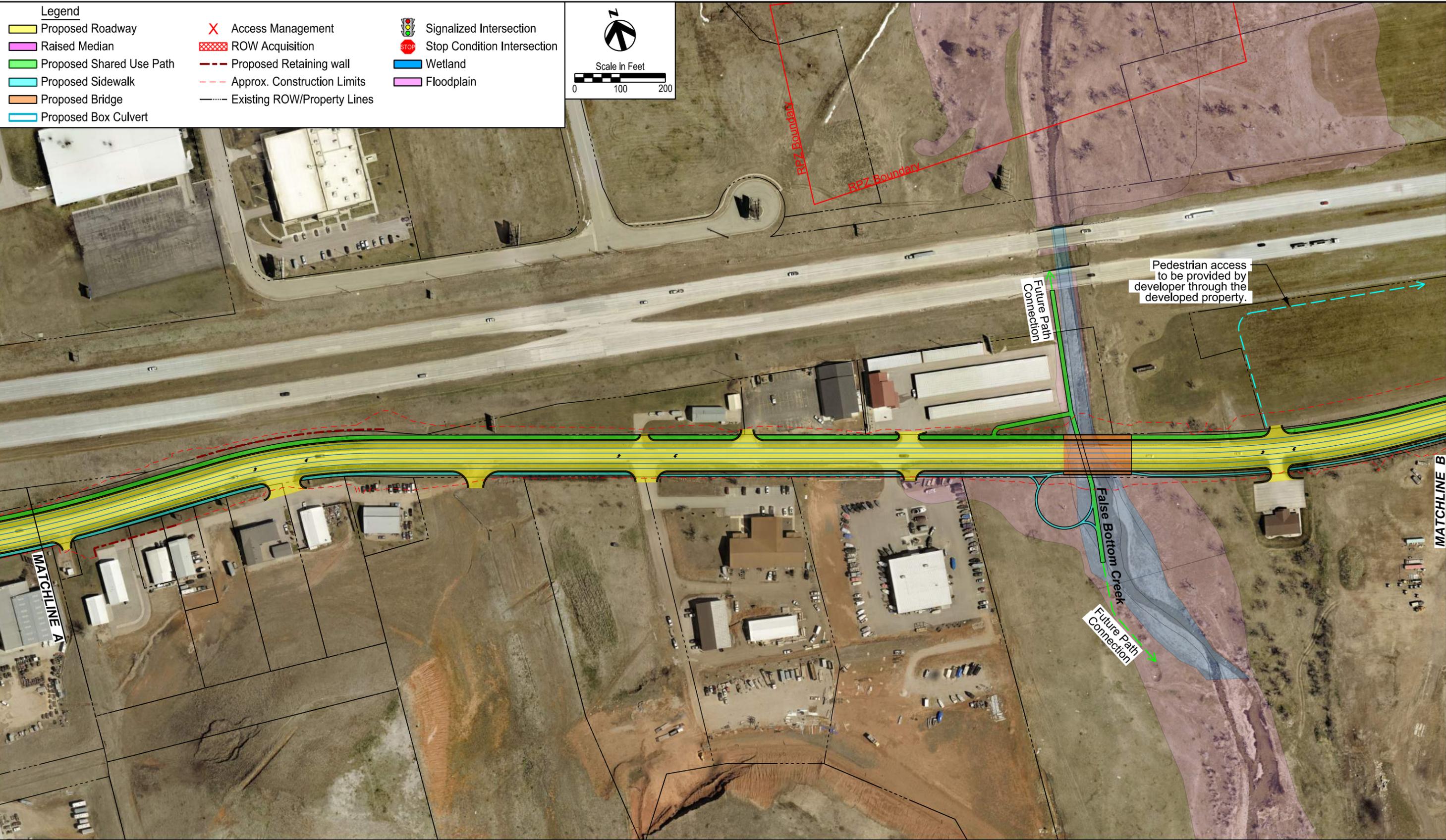


FIGURE 36

Revision:



Colorado Blvd Improvements - East of Heritage Dr to False Bottom Creek

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Figure #

36

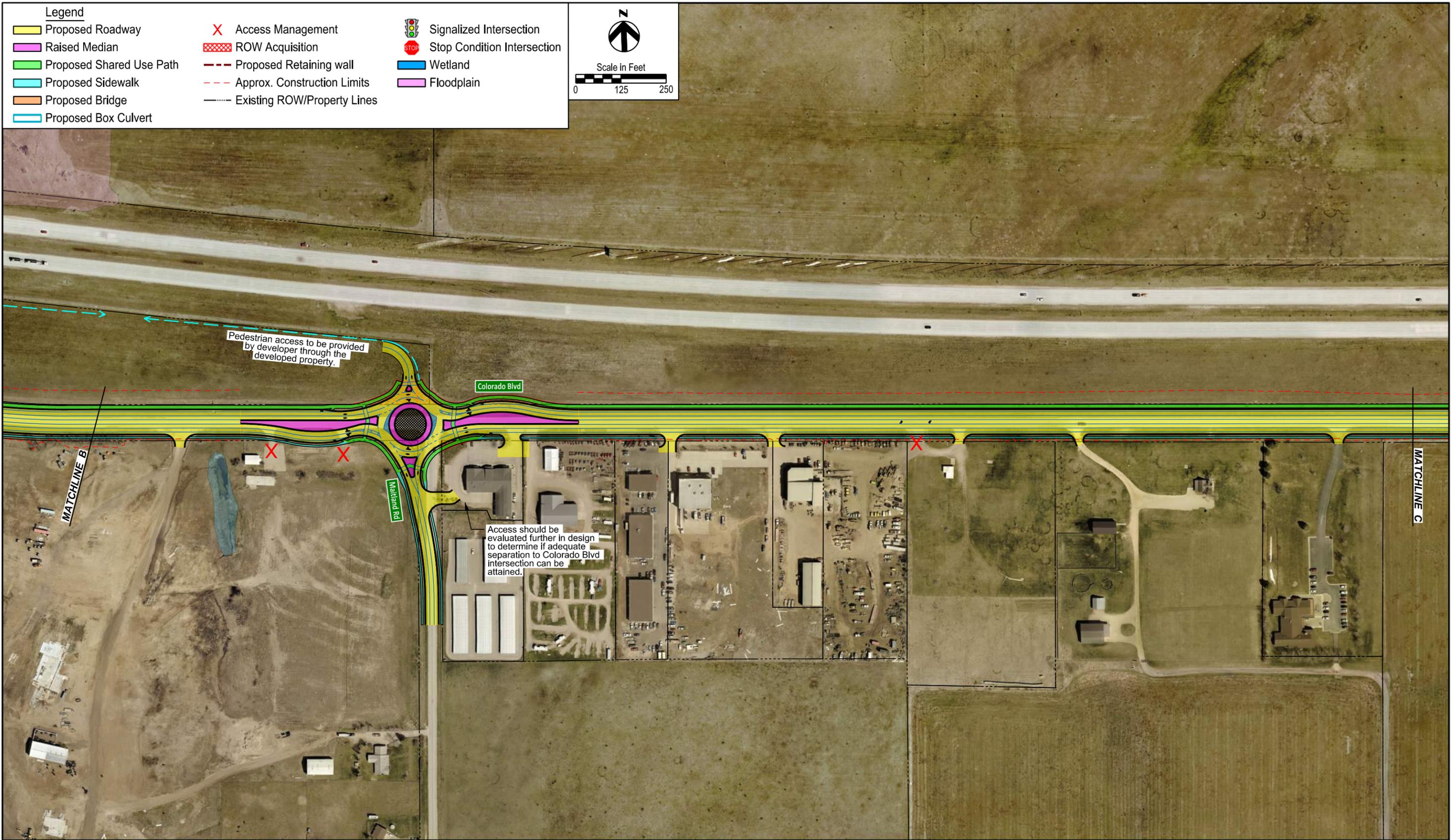


FIGURE 37

Revision:



Colorado Blvd Improvements - False Bottom Creek to West of Rainbow Rd

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Figure #

37

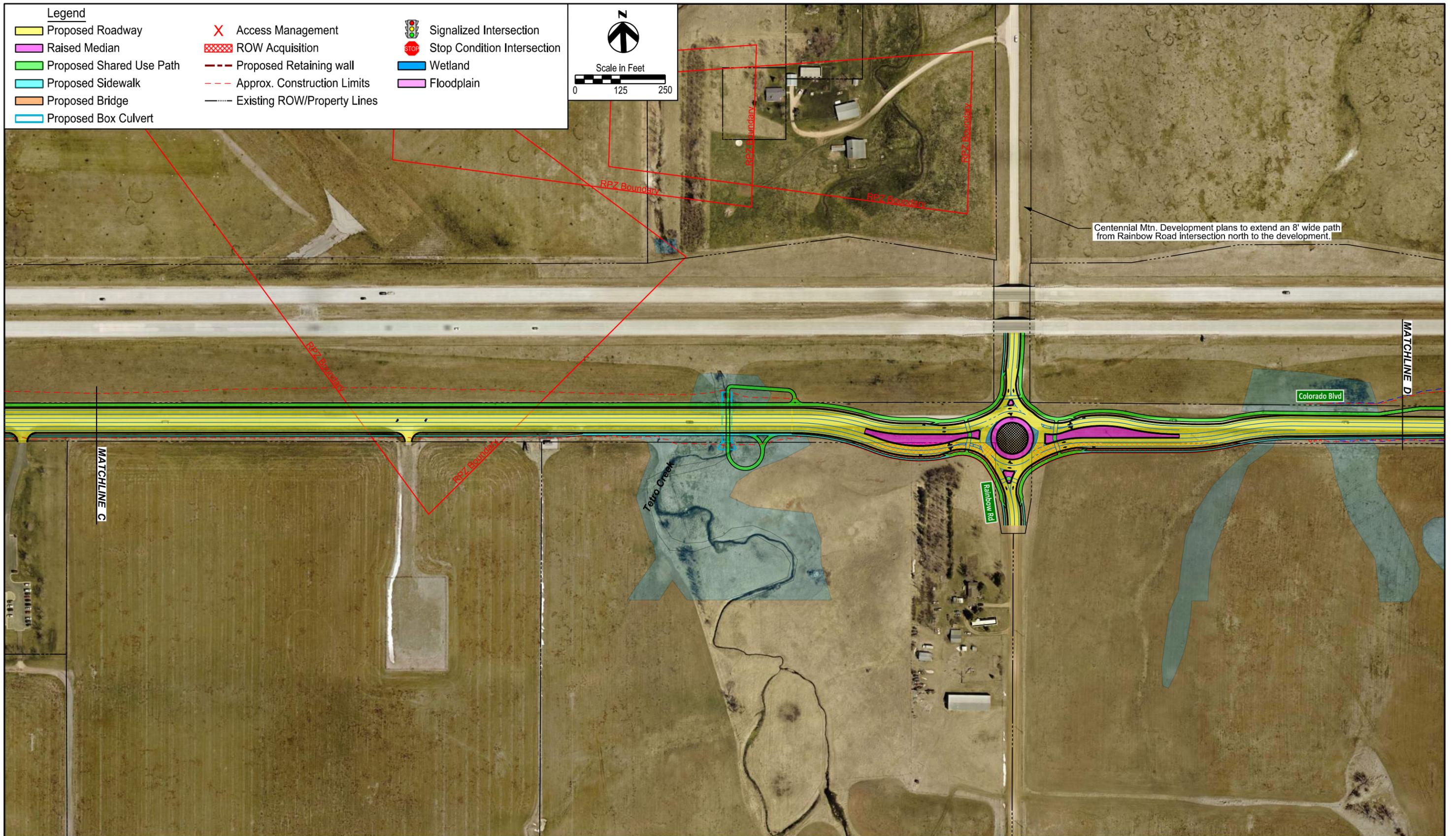


FIGURE 38

Revision:



Colorado Blvd Improvements - Rainbow Rd Area

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Figure #

38

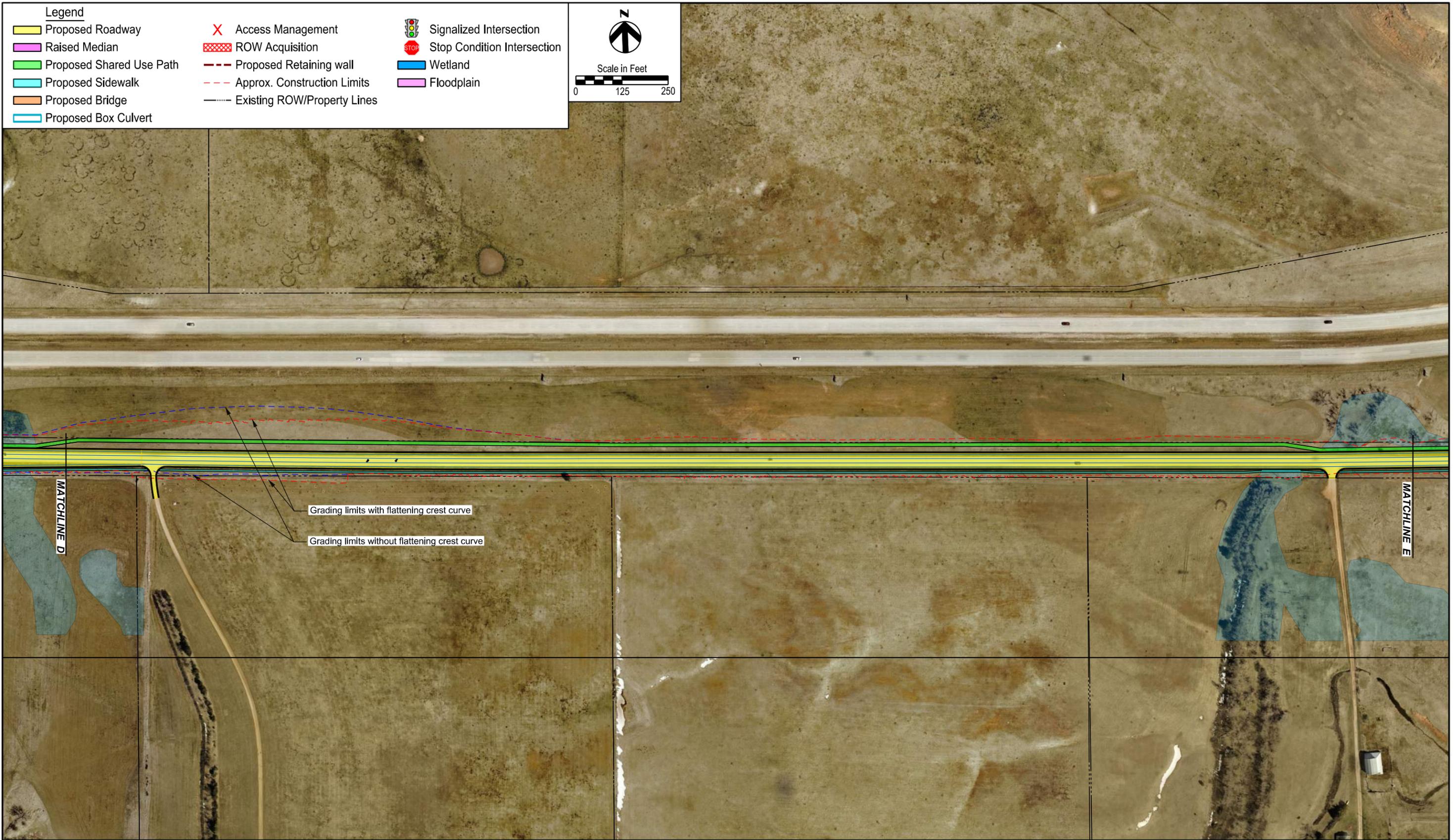


FIGURE 39

Revision:



Colorado Blvd Improvements - East of Rainbow Rd to West of Aurora Ave

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Figure #

39

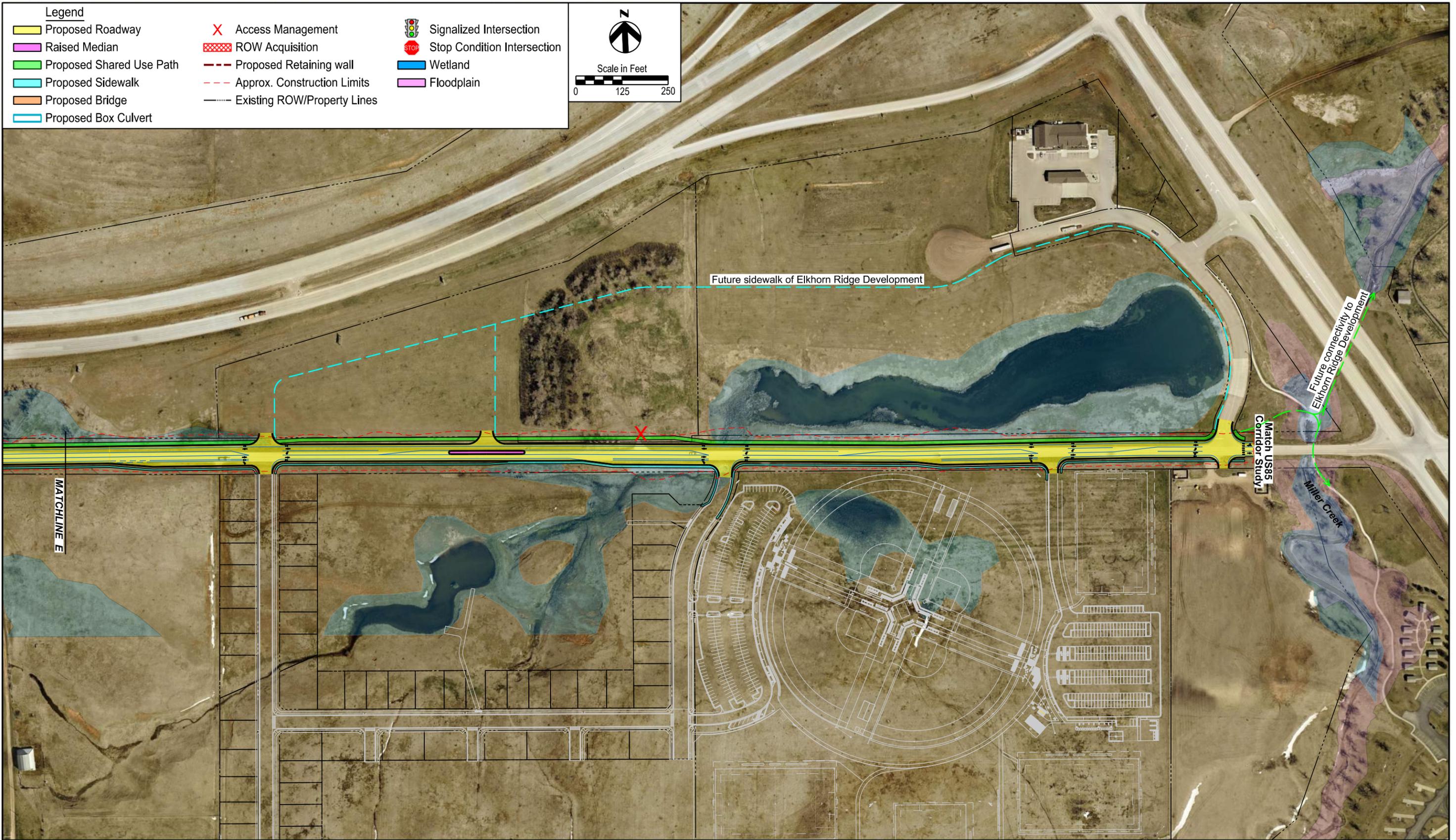


FIGURE 40

Revision:



Colorado Blvd Improvements - Aurora Ave to Colorado Lp

Colorado Blvd Corridor Study (27th Street to Colorado Loop)

Spearfish, SD

Figure #

40

Multimodal Recommendations

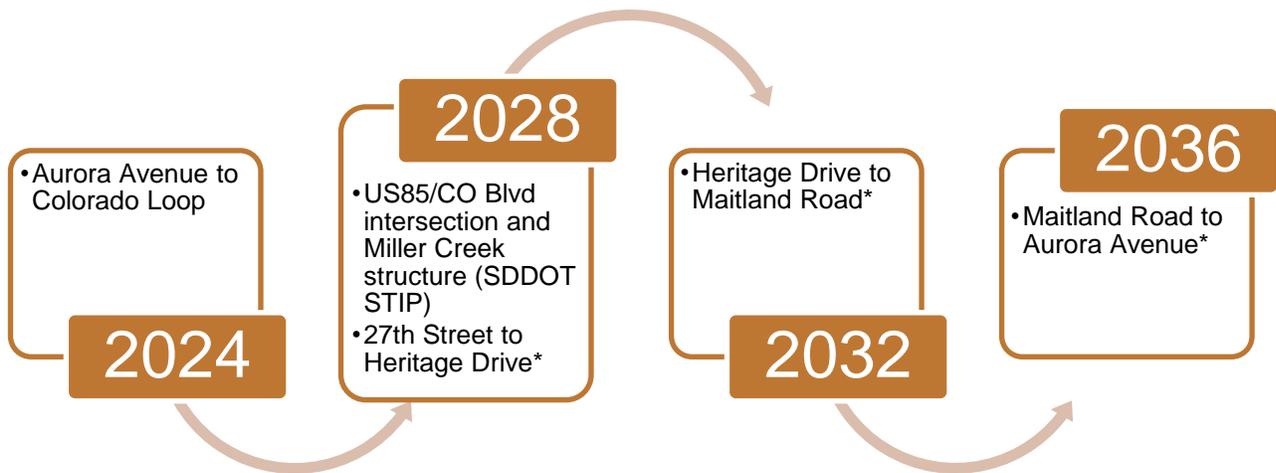
The preferred recreation path alternative was to locate the path on the north side of the roadway. The north path was largely favored by the public input received as part of the study citing it would be more enjoyable and safer for bicyclists and pedestrians, concerns regarding high-speed vehicles making turns, a high volume of large trucks/equipment utilizing the southern access points, and an east-west movement at 27th Street will be more noticeable to drivers than a north-south movement. The north path recommendation was primarily based on the 26% to 300% less total crossing vehicles and 76% to 267% less total conflict points with the north path alternative compared to that of the south path alternative. The benefit of the lower number of vulnerable roadway user crashes would outweigh the additional costs of this alternative.

Pedestrian underpasses are recommended at False Bottom Creek, Tetro Creek, and Miller Creek. A pedestrian underpass underneath the north leg of 27th Street should also be considered if funding becomes available. Connections to future auxiliary paths should occur at grade-separated crossings or at major intersections where motorists expect crossings to occur. Due to the speeds on Colorado Boulevard, it is recommended to provide rectangular rapid-flashing beacons (RRFB) or pedestrian hybrid beacons (PHB) at pedestrian/bicycle crossings that don't coincide with a pedestrian underpass or major controlled intersection. Depending on the proximity and ease of access to the Miller Creek pedestrian underpass from the Skyridge development and travel center, a RRFB or PHB at Colorado Loop is recommended due to the number of school-aged children that may be crossing at this location.

The preferred in-street bike facility option was Option 3c, uni-directional buffered bike lanes in the same direction of traffic on either side of the roadway. The second runner up if funding was not available was Option 1. The recreation path will provide bicycle connectivity for those that are not comfortable sharing the outside lane of the roadway.

9.2 Project Implementation

Based on traffic operations, the corridor’s roadway segments and associated intersections were identified for improvements by the future dates shown in **Figure 41**. Aurora Avenue to Colorado Loop is planned for reconstruction in 2024. Likewise, the US85 & Colorado Boulevard intersection along with the nearby Miller Creek structure are programmed to be reconstructed in the SDDOT’s Statewide Transportation Improvement Plan (STIP) in 2028. 27th Street to Heritage Drive is projected to be needing improvements by year 2028. Heritage Drive to Maitland Road is projected to be needing improvements by year 2032. Maitland Road to Aurora Avenue is projected to be needing improvements by year 2036.



*Dates shown are based on timeline of need. Date of construction will be based on funding availability.

Figure 41. Project Implementation Plan